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LASER WINDOW TEST APPARATUS OPERATION AND MAINTENANCE MANUAL (F--ETC(U)
MAY 75 F29601-73-C-0124
UNCLASSIFIED AFWL-TR-75-150-VOL-3 NL

1 OF 2
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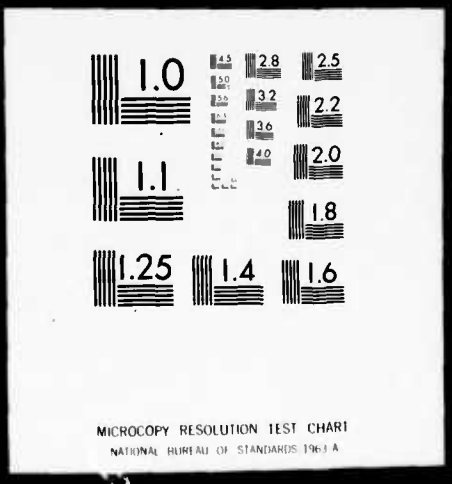

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LASER WINDOW TEST APPARATUS

OPERATION AND MAINTENANCE MANUAL
(For the Test and Evaluation of Optical Components for the Airborne Laser Laboratory)

VOLUME III

CIRCUIT DIAGRAMS AND SCHEMATICS

MAY 1975

Prepared for the

Air Force Weapons Laboratory (LRE)
Kirtland Air Force Base
Albuquerque, New Mexico 87117

Under
Data Item A010
Contract F29601-73-C-0124

by

UNIVERSITY OF DAYTON
RESEARCH INSTITUTE
DAYTON, OHIO 45469

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FOREWORD

The material contained in this volume is called for as Item A010 of Exhibit A to Contract F29601-73-C-0124, "Test and Evaluation of Optical Components for the Airborne Laser Laboratory." Capt. John Loomis/LRE, Air Force Weapons Laboratory, Kirtland AFB, NM, 87117, served as project officer.

The basic information for this document was prepared by the technical staff of the University of Dayton Research Institute assigned to the project. It is to be noted that this document is Volume III of the four-volume LWTA Operations and Maintenance Manual, the other three of which are identified as:

Volume I Description and Principles of Operation
Volume II Setup, Alignment, Calibration, and Operation
Volume IV Operations, Software Programs, and Listings

This manual is intended as a working document in that it is designed to be constantly in use; and to be modified, changed, or upgraded as conditions warrant. The format for this document (Volume III), therefore, is such that updating modifications can be made directly to the circuits/wiring sketches herein so that correct information is always available, and that costly mistakes can be avoided. For example; information is only presented on one side of each page, and this document is bound in such a manner as to make all pages herein readily replaceable.

TABLE OF CONTENTS

SECTION 1

INTRODUCTION

1.1 SCOPE

This volume contains schematic diagrams and cable connection drawings for the Laser Window Test Apparatus (LWTA), which has been installed at the Air Force Weapons Laboratory as part of the Laser Window Evaluation Laboratory. The LWTA was constructed by the University of Dayton Research Institute under Contract No. F29601-72-C-0122, and was operated during the reporting period under Contract No. F29601-73-C-0124, for the purpose of evaluating infrared (IR) windows and other components in support of the Airborne Laser Laboratory (ALL) development program. The LWTA is installed in Room 100, Building 418, Kirtland Air Force Base, New Mexico, as an integral part of the Laser Window Evaluation Laboratory.

It should be noted that the LWTA is a highly complex and flexible scientific instrument system. As such, it is expected to undergo constant evolutionary changes during its operating lifetime. This documentation, therefore, is written to describe the configuration of the apparatus as it existed at the end of January 1975.

This section of this volume explains the contents and organization of the remainder of the volume; and it provides instructions, in the form of tables and illustrations, on how to find a particular drawing or diagram. Section 2 herein, contains those referenced drawings and diagrams. To be of greatest possible use to the reader, it is intended that this volume be used in conjunction with Volume II, which discusses routine operating instructions -- including loading, setting up, manual manipulation, and automatic operation of the apparatus. The other volumes in this series are identified in the Foreword.

1.2 ORGANIZATION OF DIAGRAMS

This subsection contains the "how to" discussions -- relating how to find a circuit, drawing, etc. within the remainder of the document; by reference to Chassis or Groups, or by reference to the index of Circuits and Components.

1.2.1 Chassis Numbering Scheme

Each subassembly that is part of the electronics package of the LWTA has been given a "black box" or chassis number, which was determined from its relationship with various functional groups. Figures 1-1 and 1-2

present block diagrams of the photometer and interferometer circuitry to show these groupings. The significance of these groupings is as follows:

Number Series	Function or Description
100	Components mounted in control console electronics rack
200, 300	Interconnecting cables between control room and optics room
400	Numerical Control
500	Joystick
600	Photometer preamplifier
700	Calibration mirrors, photometer
800	Interferometer X-Y encoders
900	Photometer beam dump
1000	Wavetek CRT unit interconnections
1100	Computer-controlled power bus
1200	Environmental and table-position controls and sensors
1300	Power panel
1400, 1500	Operator manual intervention
1600	Replaced by 2000
1700	Interferometer Doppler mirror drive
1800	Interferometer detectors and preamplifiers
1900	Audible/visual alarm circuit
2000	Sync pulse generator and chopper drives

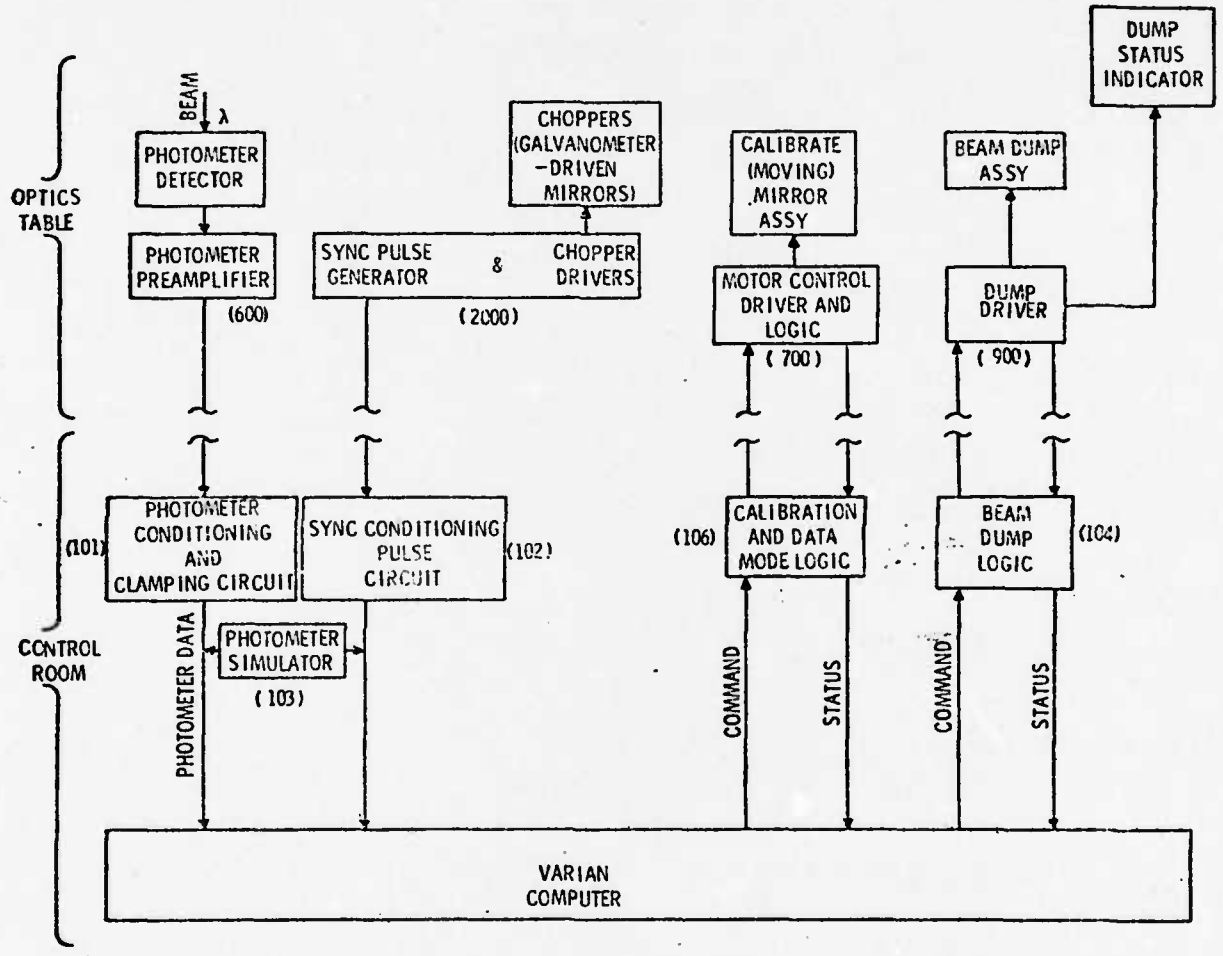


Figure 1-1. Photometer Electronics Block Diagram. (Numbers in Parentheses are Chassis Numbers.)

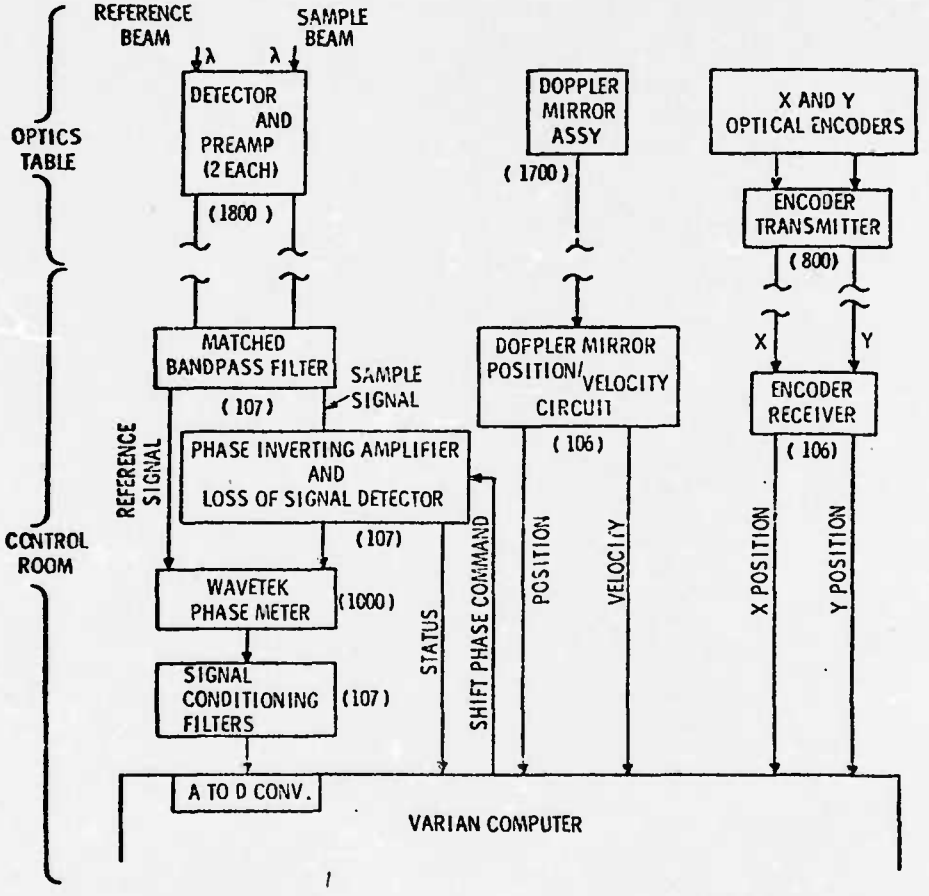


Figure 1-2. Interferometer Electronics Block Diagram. (Numbers in Parentheses are Chassis Numbers.)

1.2.2 Arrangement of Groups

The wiring and interconnecting information related to each of the previously referenced groups is contained in Section 2. The first page within each group has been reproduced on colored paper, so that that group can more easily be located within the volume. The diagrams within each group are arranged in numerical order, by chassis number.

Chassis numbers are also assigned to cable connectors, even where there are cable-to-cable connections with no electronic components are involved. One cable connector drawing may have several numbers, such as "P/J201, P/J301," which is interpreted as follows, "P" and "J" refer to a plug and a jack, respectively. Plugs and jacks may either be mounted to a panel or box, or they may be attached to the end of a cable. When two or more numbers are indicated (as in the example), it means that those connections are wired one-to-one in a series (similar to extension cords), between the components that they service.

An index of circuit descriptions, with their corresponding chassis numbers and beginning page numbers, appears in Table 1-1. Figure 1-3 is a layout diagram that shows the relative locations of those major cable connectors that are the main communication lines between the control room and the optics room.

1.2.3 Arrangement Within Groups

Although the arrangement within groups may vary somewhat, the basic arrangement of most groups (in Section 2) consists of a block diagram for the related chassis (and the numbering assigned); followed, in turn, by applicable terminal board or connection diagrams, schematics, circuit diagrams, and supplementary information, where required.

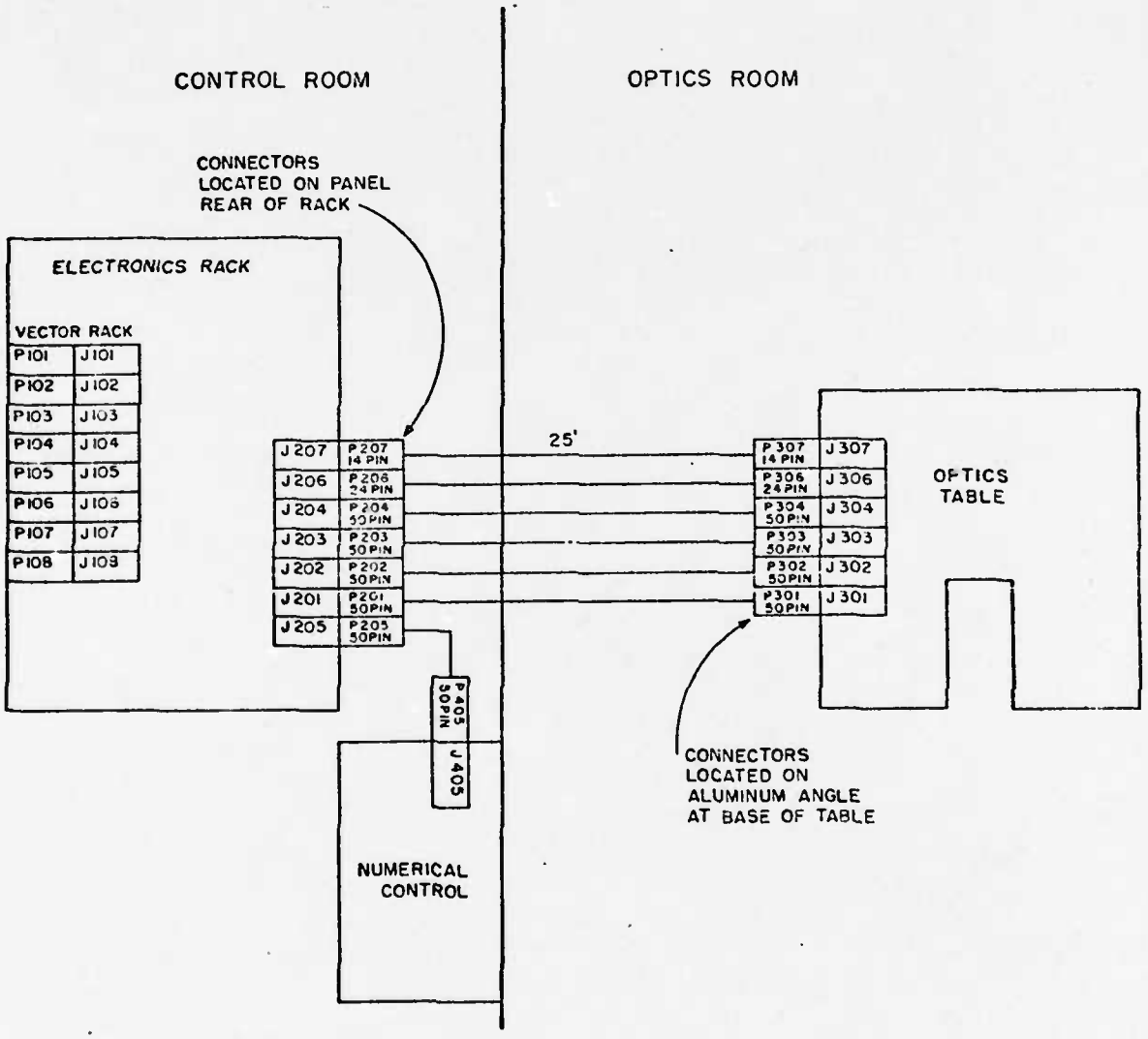


Figure 1-3. Locations of Major Cable Connections.

TABLE 1-1. INDEX OF CIRCUITS AND COMPONENTS

TABLE 1-1 (Continued)

Circuit Description or Location of Connector	"Black Box" or Chassis Numer	Page
Rack-Mounted Power Supply Panel (24-Volt General Purpose Power Supply) Logic Power Supply Panel (Console 5V Power Supply), Operator Manual Intervention Circuit	1400, 1500	2-80
Doppler Mirror	1700	2-83
Interferometer Reference/Sample Detector Circuitry	1800	2-86
Audible/Visual Alarm	1900	2-90
Quad & Frame Sync Chassis (Replaces 1600 Series)	2000	2-93

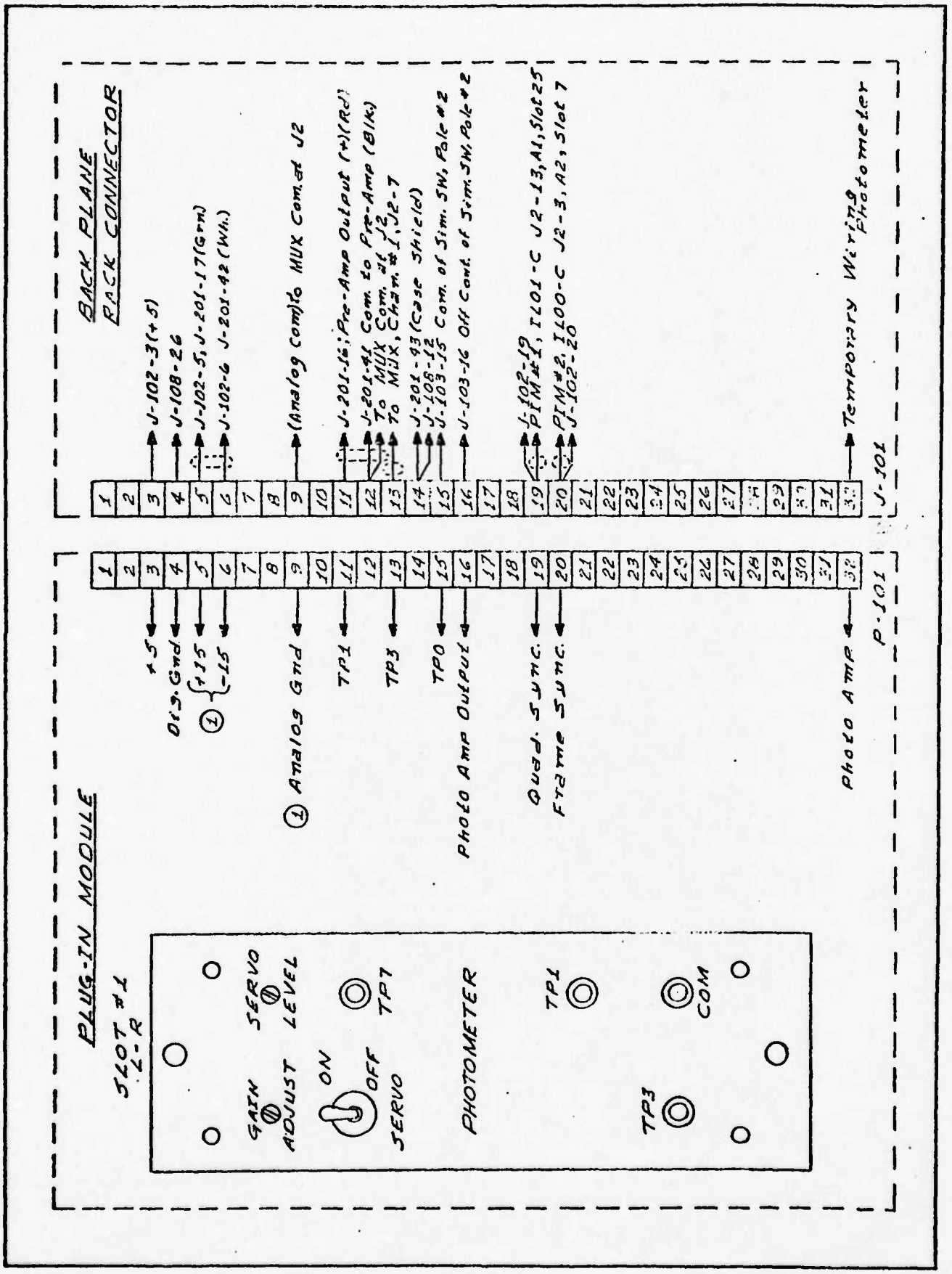
1.4 HOW TO USE THE DIAGRAMS

To trace a signal from end to end, start at the "black box" end and work back toward the control room. For example, the photometer beam dump circuit is chassis 900. All the connectors associated with this circuit will have numbers in the 900-series, such as 901, 902, etc. The schematics, wiring diagrams, and connection diagrams for the series will show the origin of the signal and the terminal number of the first connector traversed by the signal. The block wiring diagram for the 900-series will show the path to a main connector (usually a 200/300 series). Locate that connector by its number in Section 2 of this volume, and find the to-and-from connection for the signal being traced. This will show the terminal number of the ultimate destination of the signal.

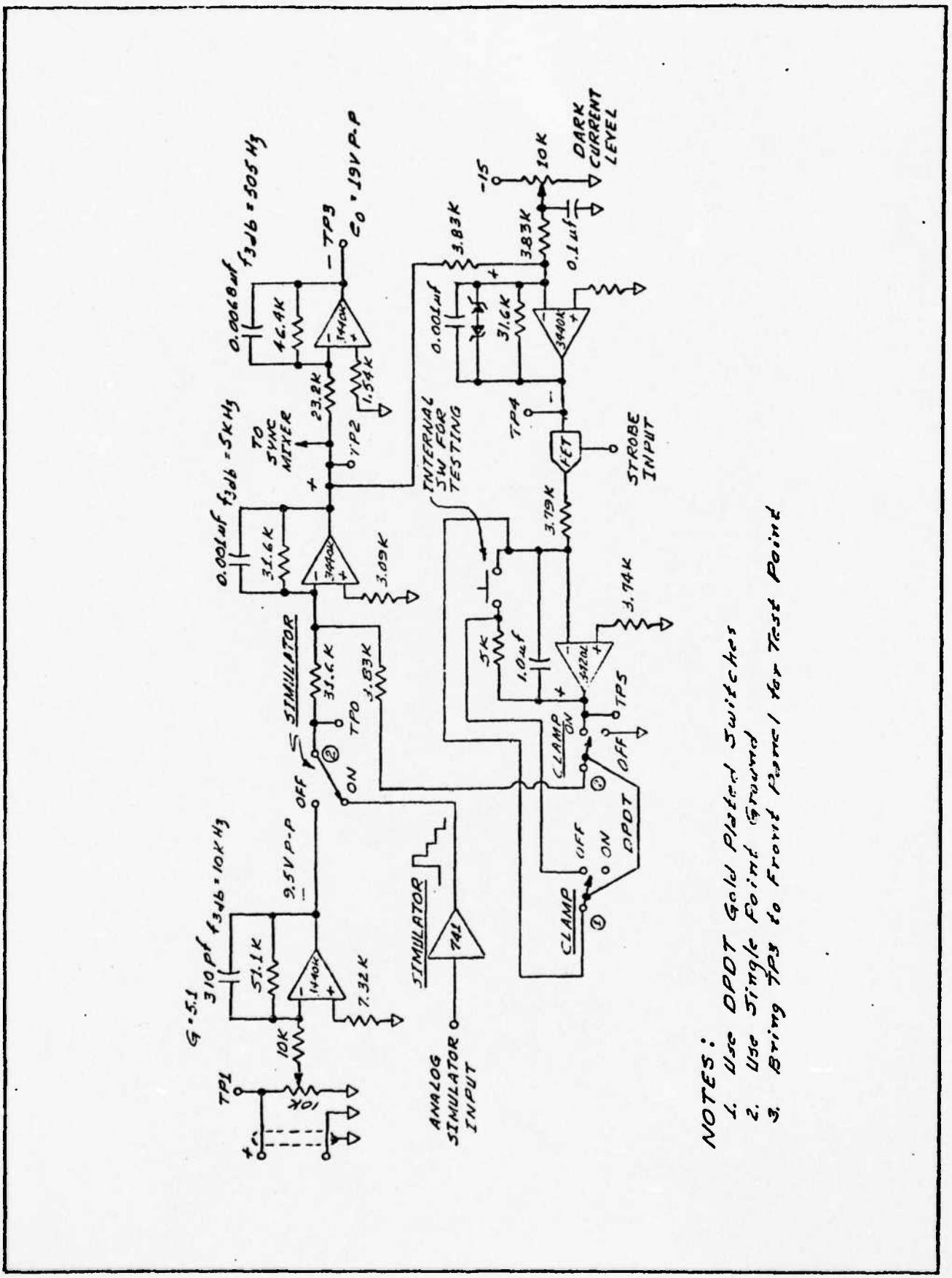
SECTION 2

DIAGRAMS

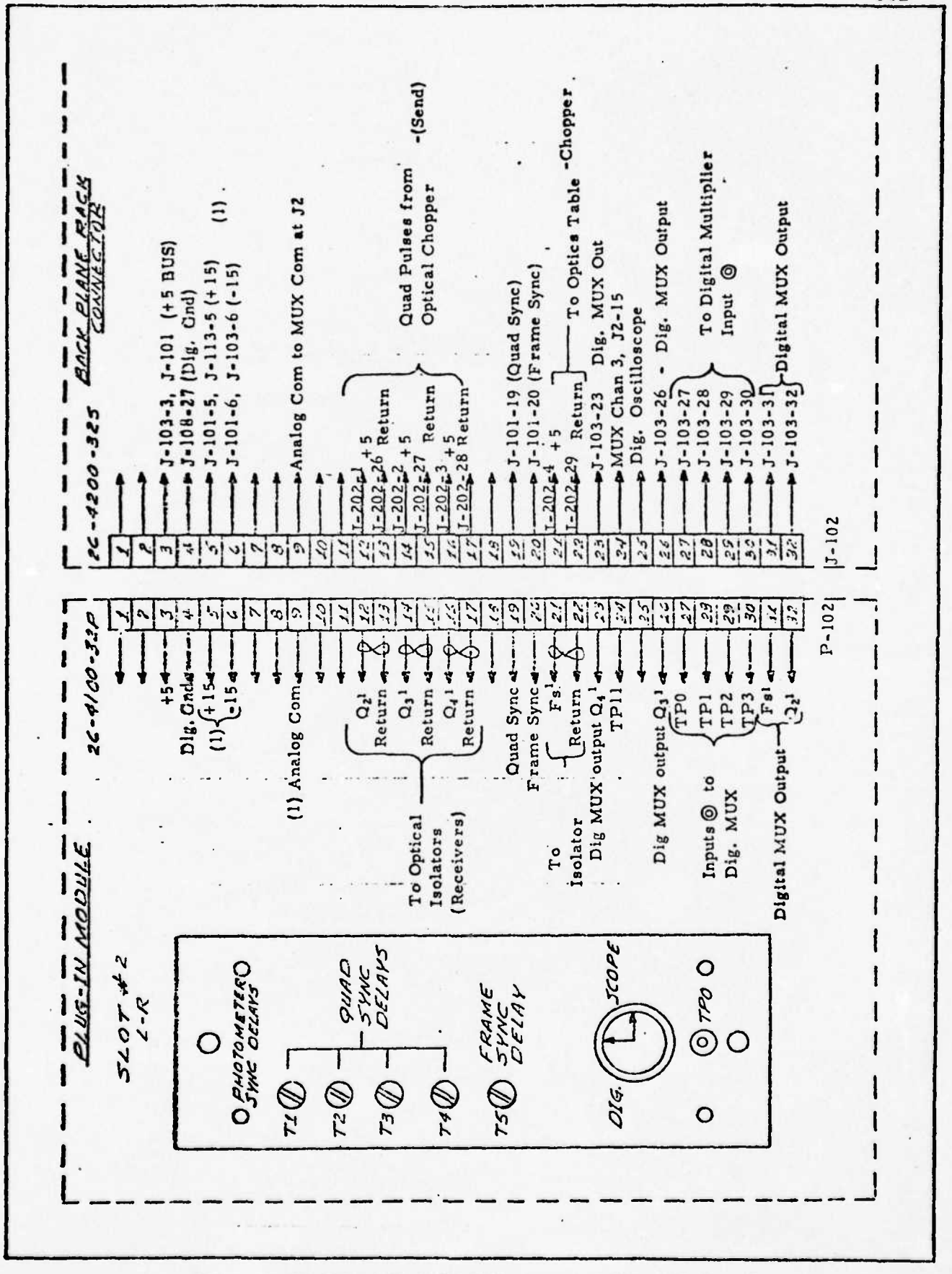
2.1 COMPONENTS MOUNTED IN CONTROL CONSOLE VECTOR RACK (100 SERIES)



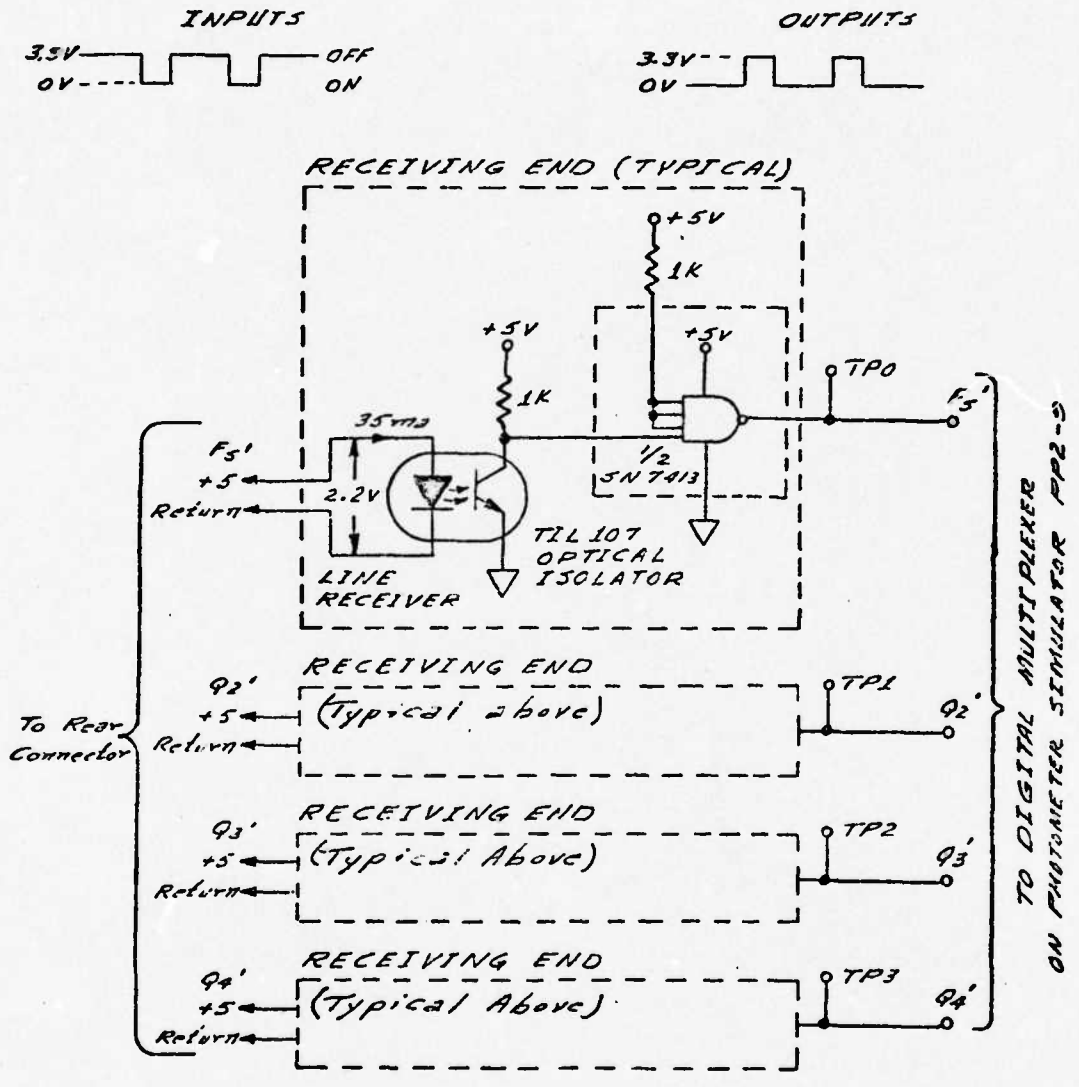
Plug-In Module, Slot #1 (Photometer)



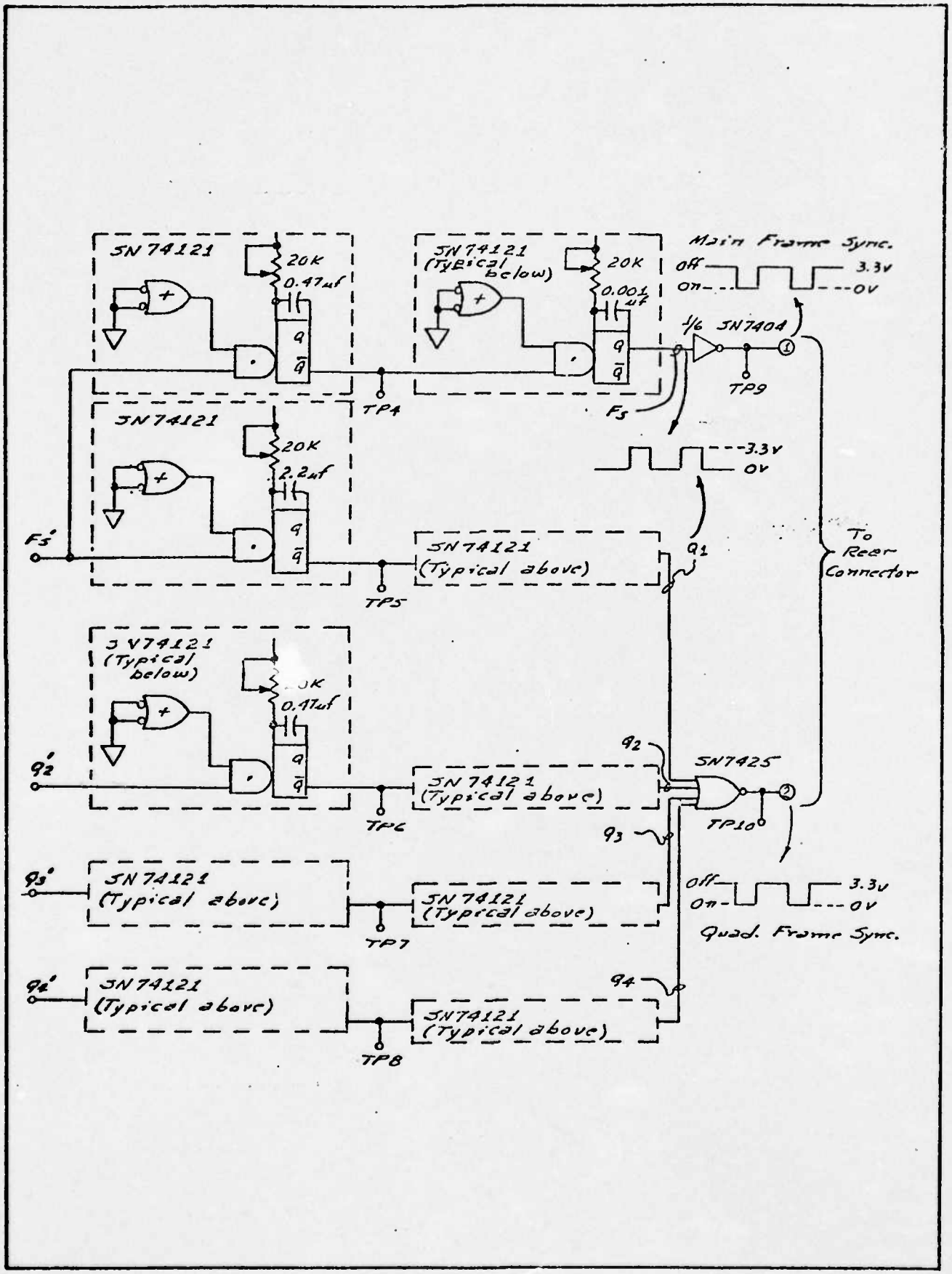
Photometer, Mod. II



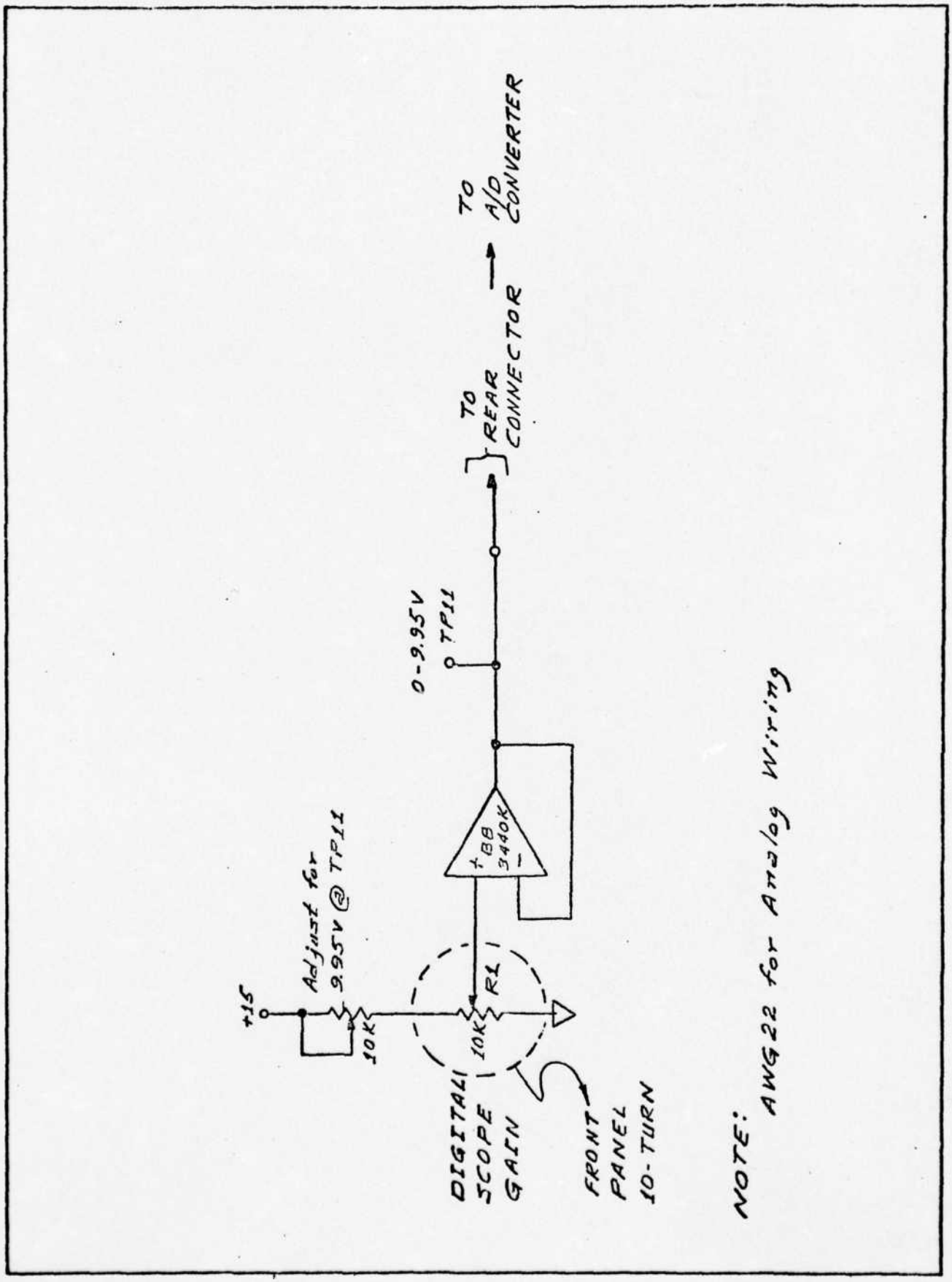
Plug-In Module, Slot #2 (Photometer Sync Delays)



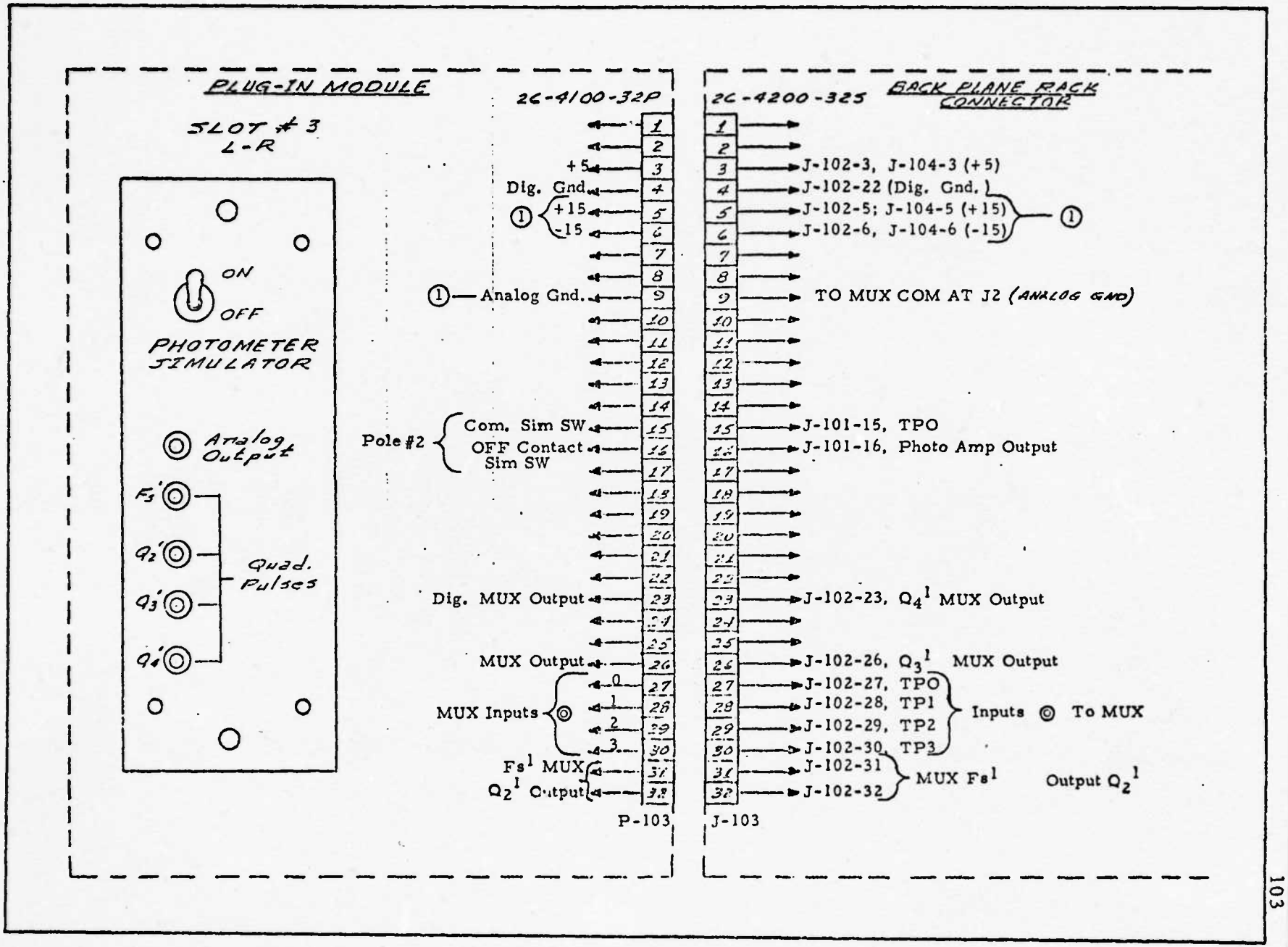
Photometer Quad and Mainframe Syncs (Sheet 1 of 2)



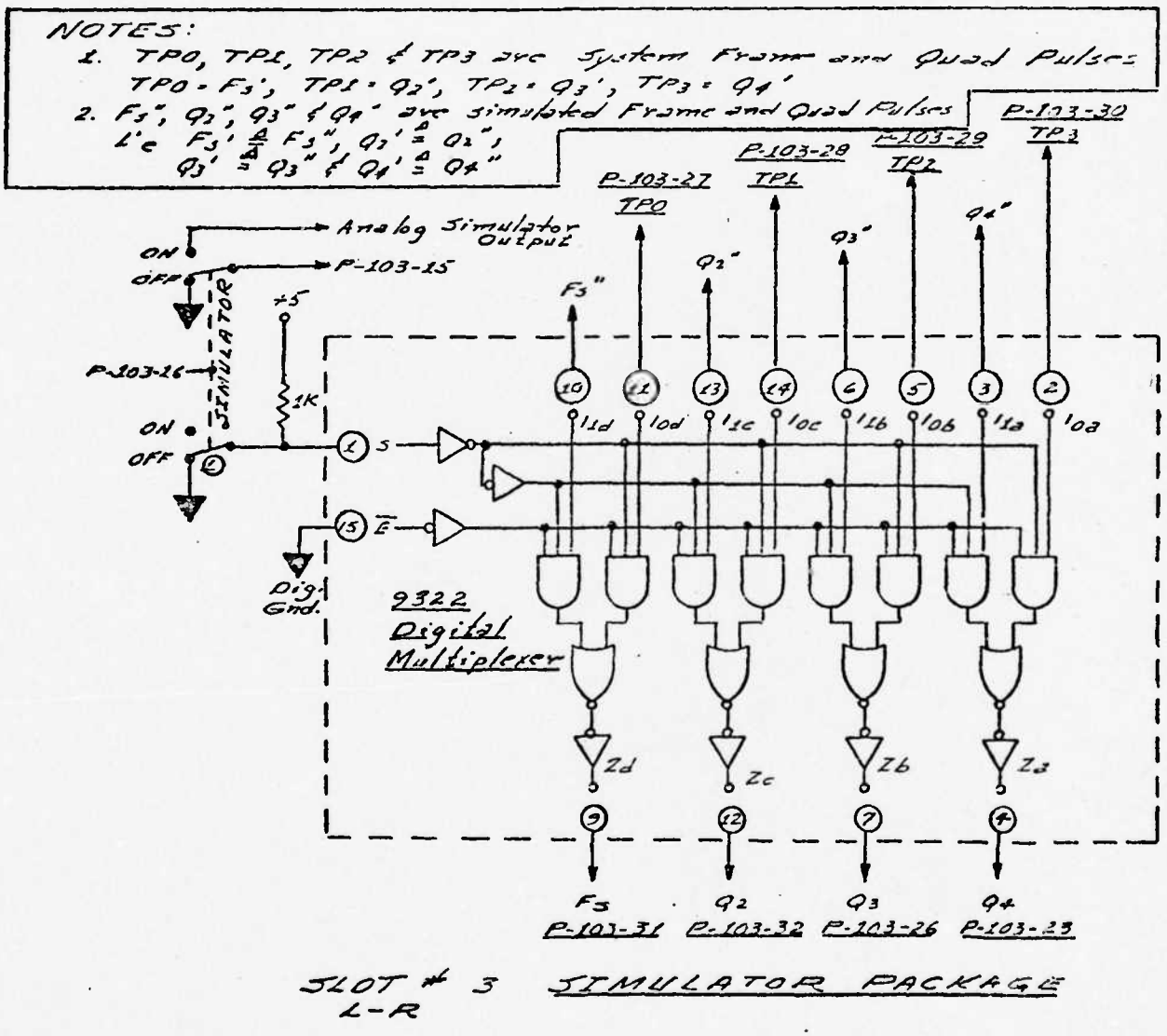
Photometer Quad and Mainframe Syncs (Sheet 2 of 2)

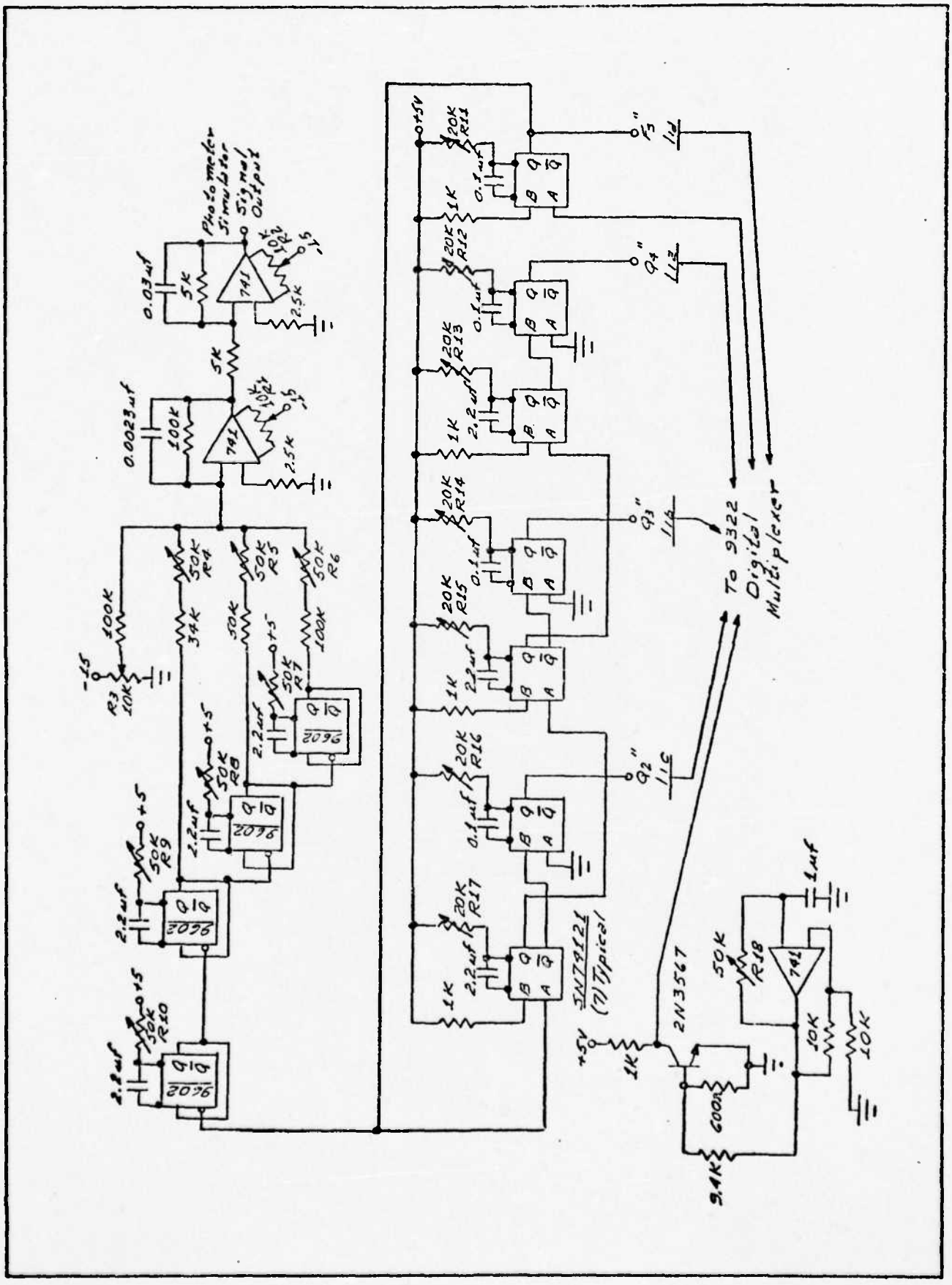


Digital Oscilloscope Input

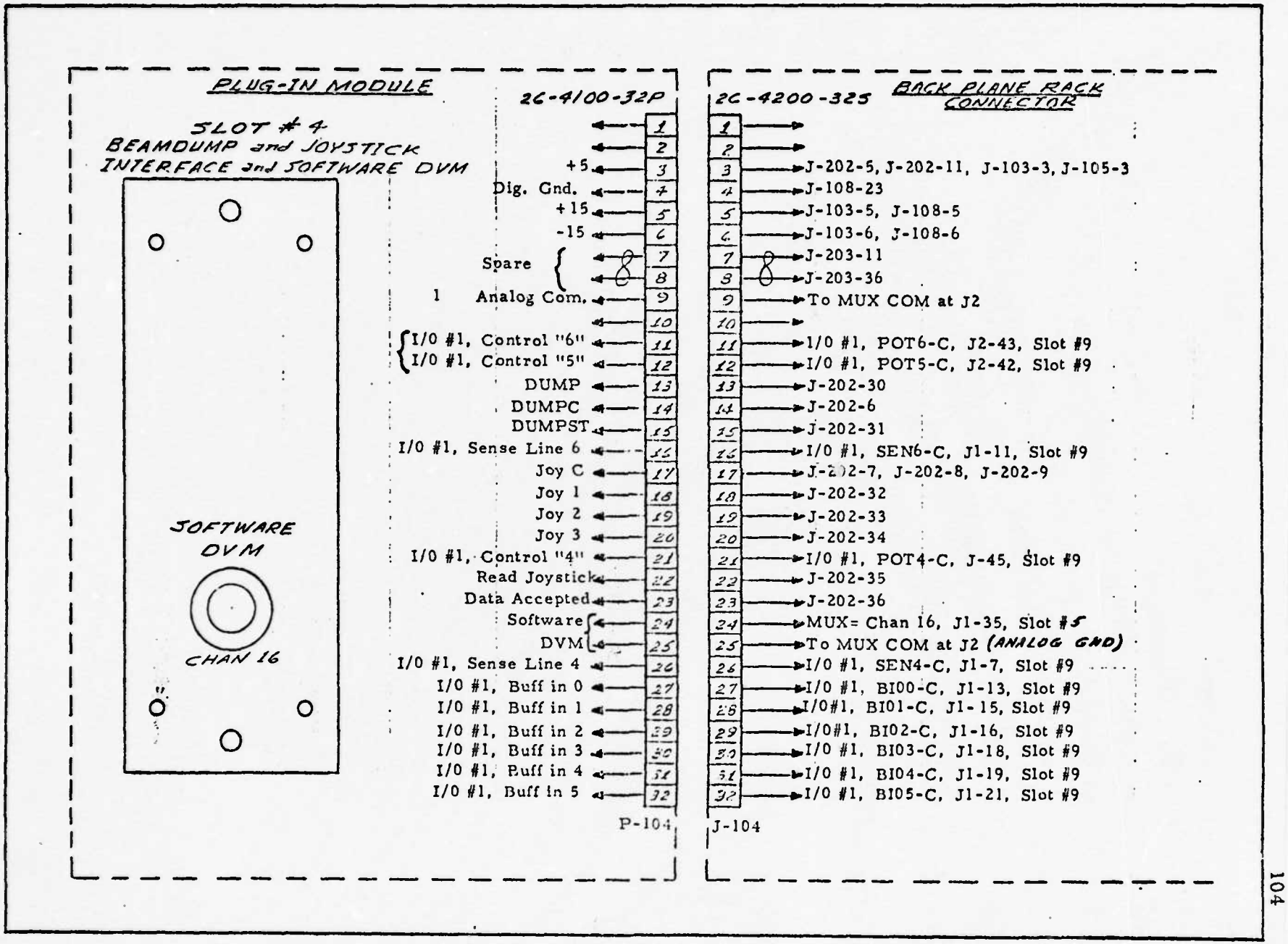


Plug-In Module, Slot #3 (Photometer Simulator)

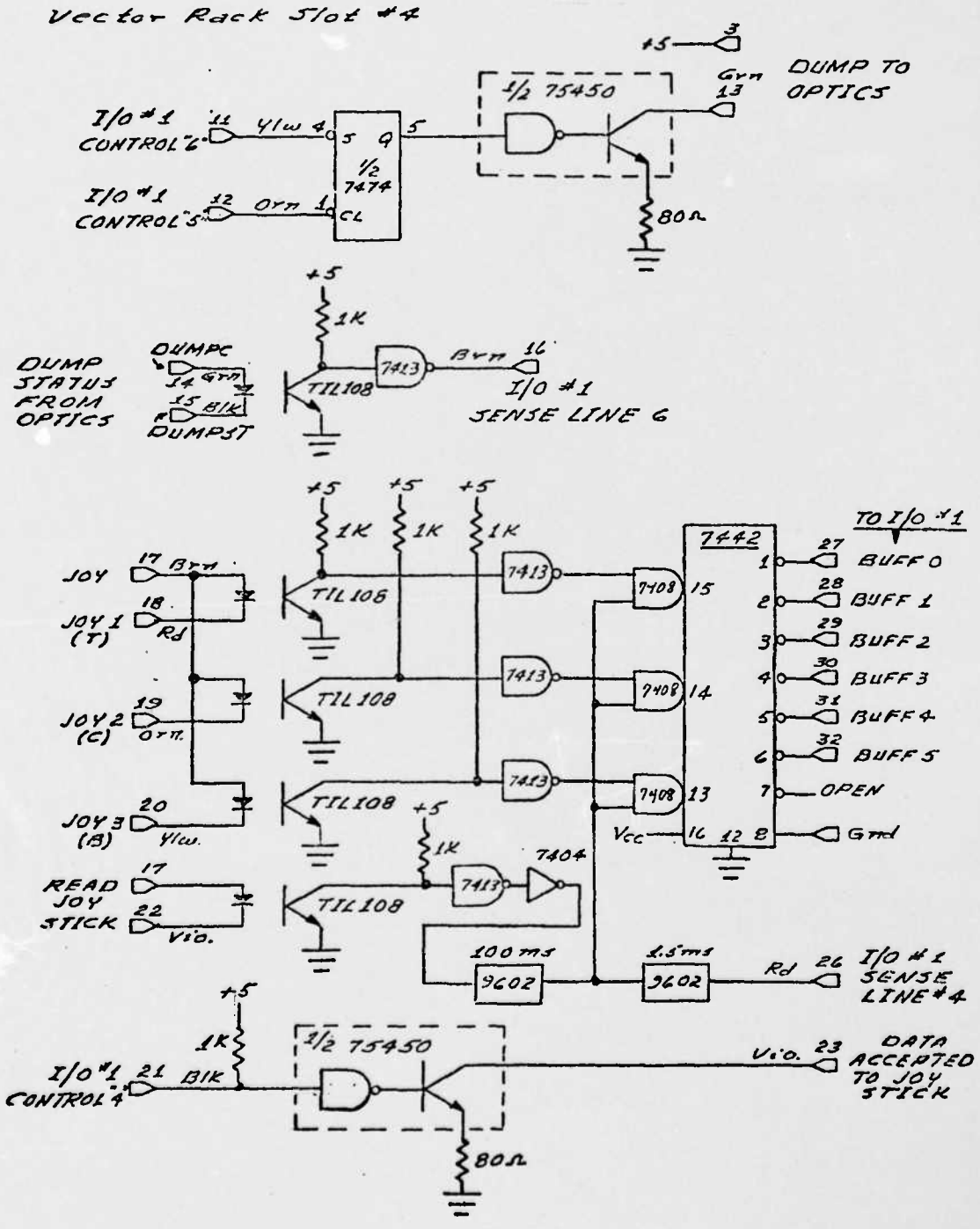

NOTES:
1. TP0, TP1, TP2 & TP3 are System Frame and Quad Pulses
TP0 = F3', TP1 = Q2', TP2 = Q3', TP3 = Q4'
2. F3", Q2", Q3" & Q4" are simulated Frame and Quad Pulses
i.e F3' ≙ F3", Q2' ≙ Q2",
Q3' ≙ Q3" & Q4' ≙ Q4"
P-103-30
TP3
P-103-29
TP2
P-103-28
TP1
P-103-27
TP0
Analog Simulator Output
ON
OFF
P-103-15
+5
SIMULATOR
P-103-16
1K
ON
OFF
S
E
Dig. Gnd.
9322
Digital
Multiplexer
F3"
Q2"
Q3"
Q4"
11d
10d
11c
10c
11b
10b
11a
10a
Zd
Zc
Zb
Za
F3
Q2
Q3
Q4
P-103-31
P-103-32
P-103-26
P-103-23
SLOT # 3 SIMULATOR PACKAGE
L-R



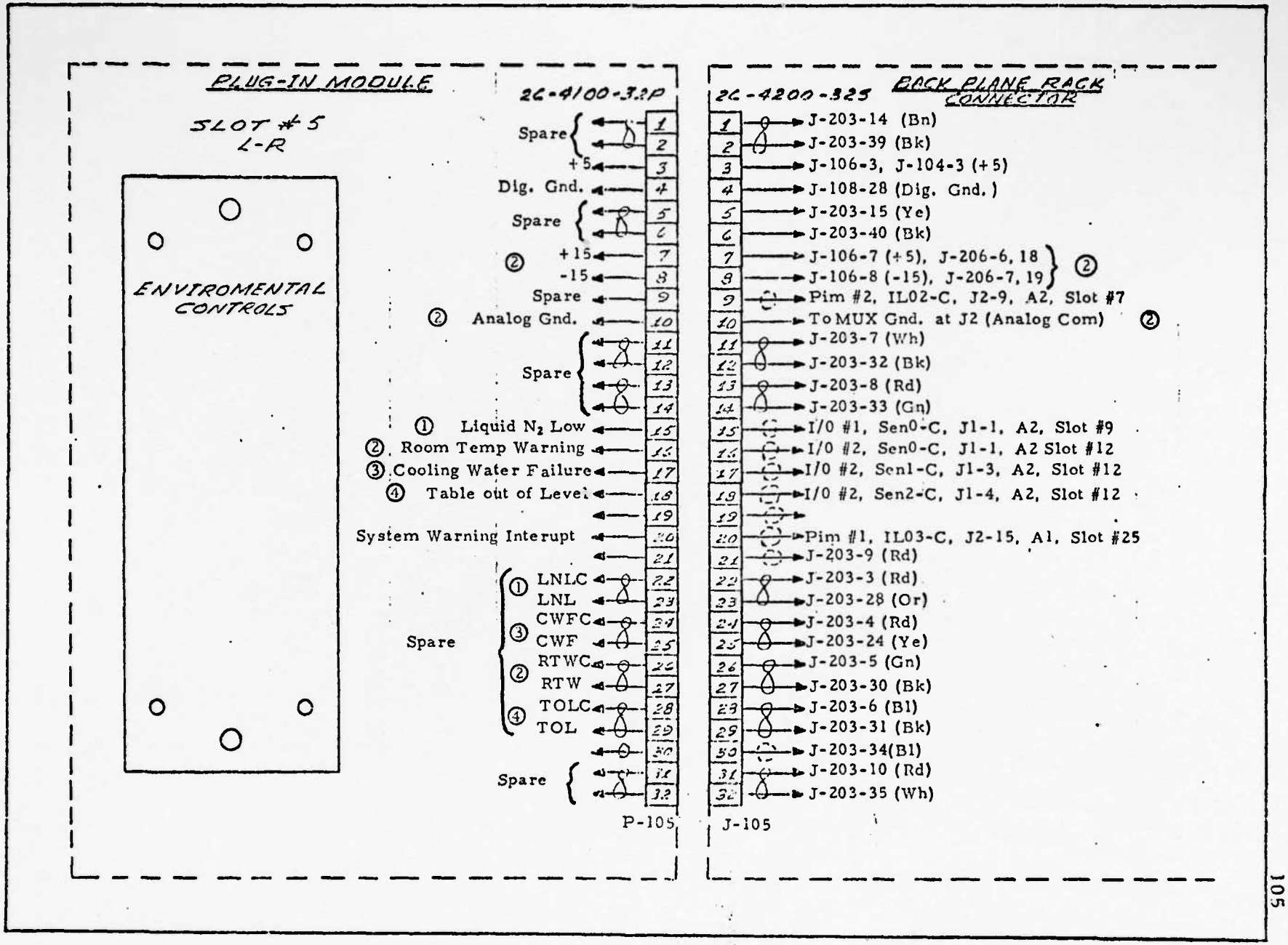
Photometer and Quad Sync Simulator, 13 Hz Clock



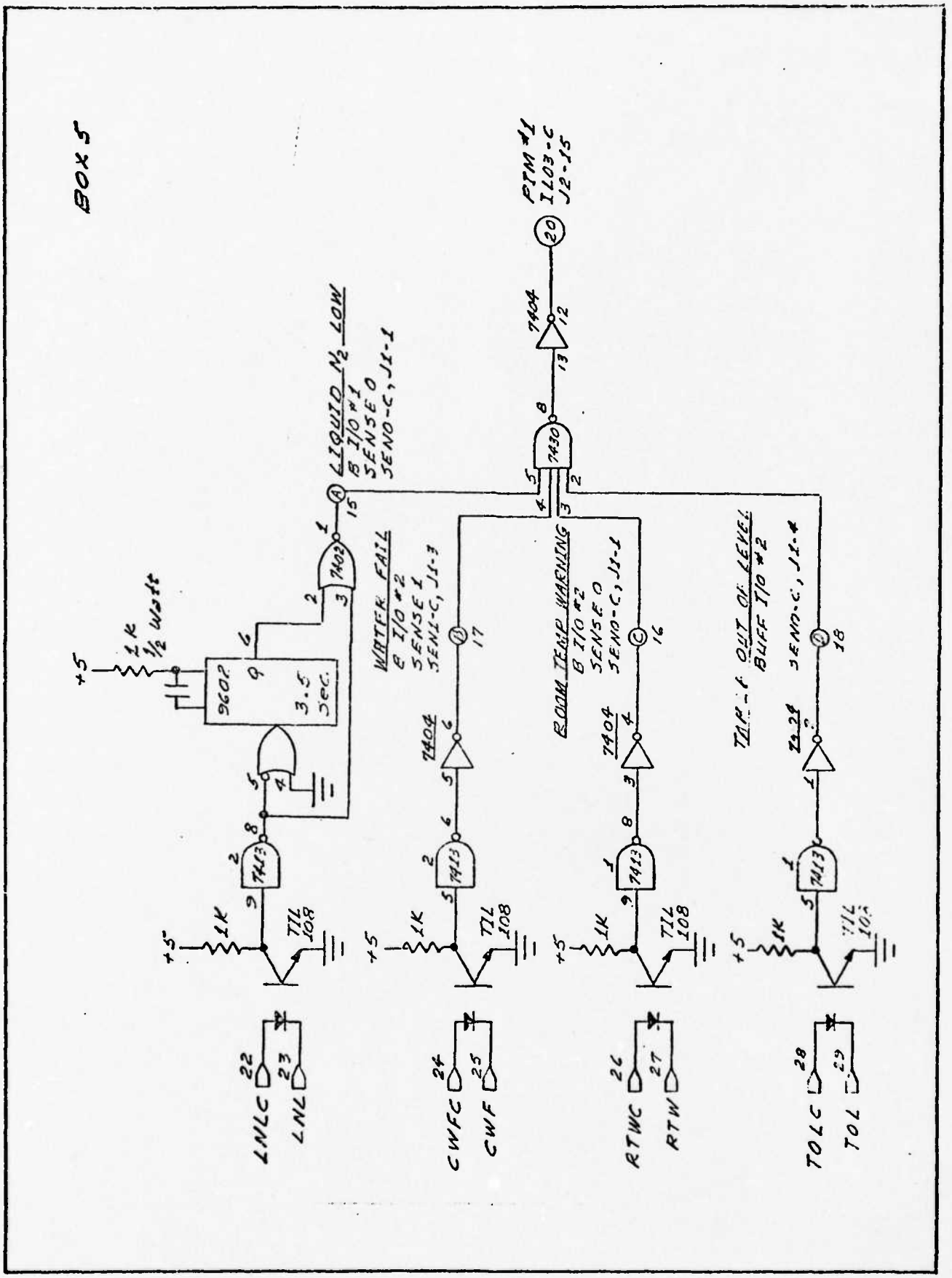
Plug-In Module, Slot #4 (Beam Dump and Joystick Interface and Software DVM)



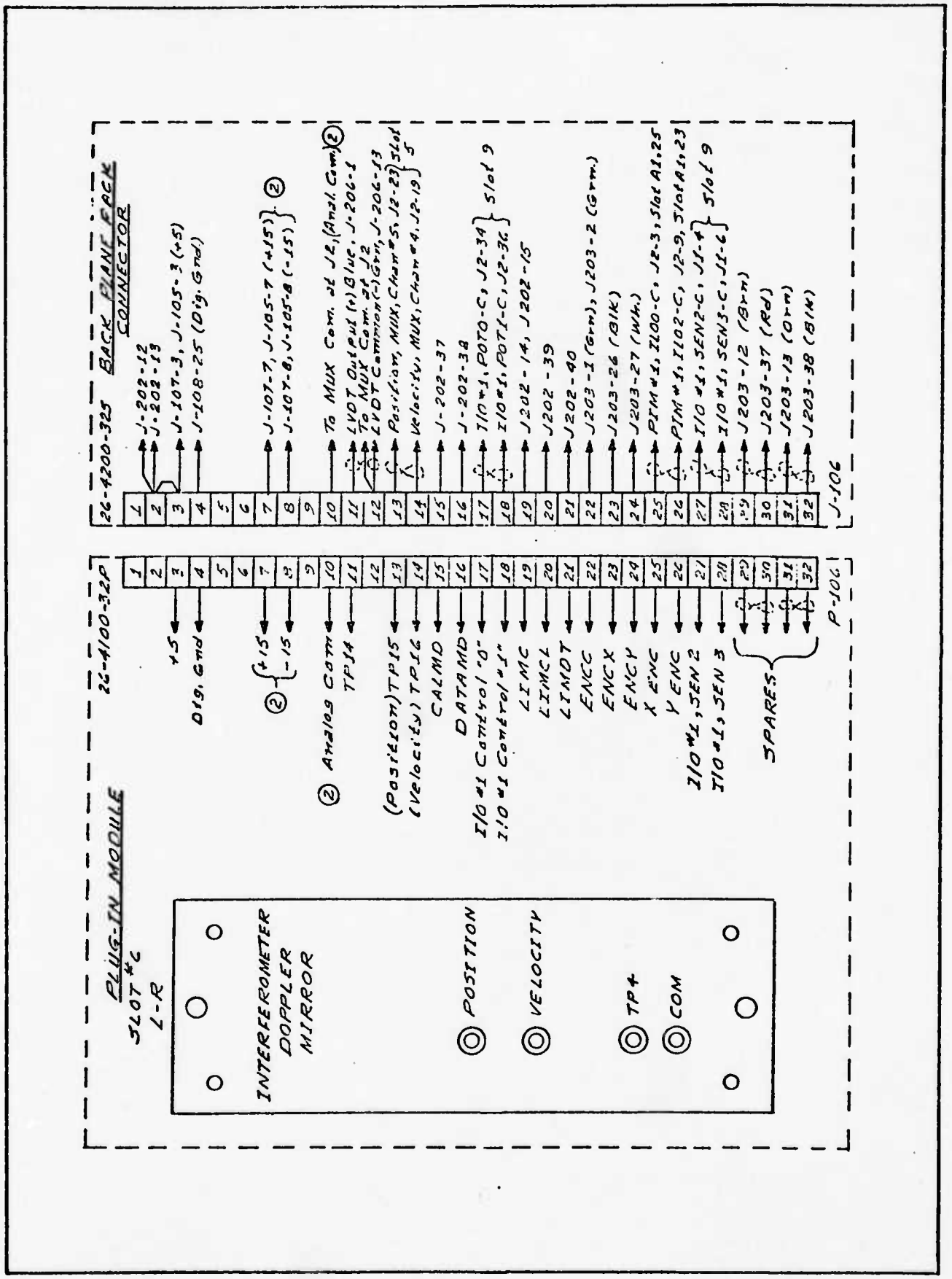
Beam Dump and Joystick Interface



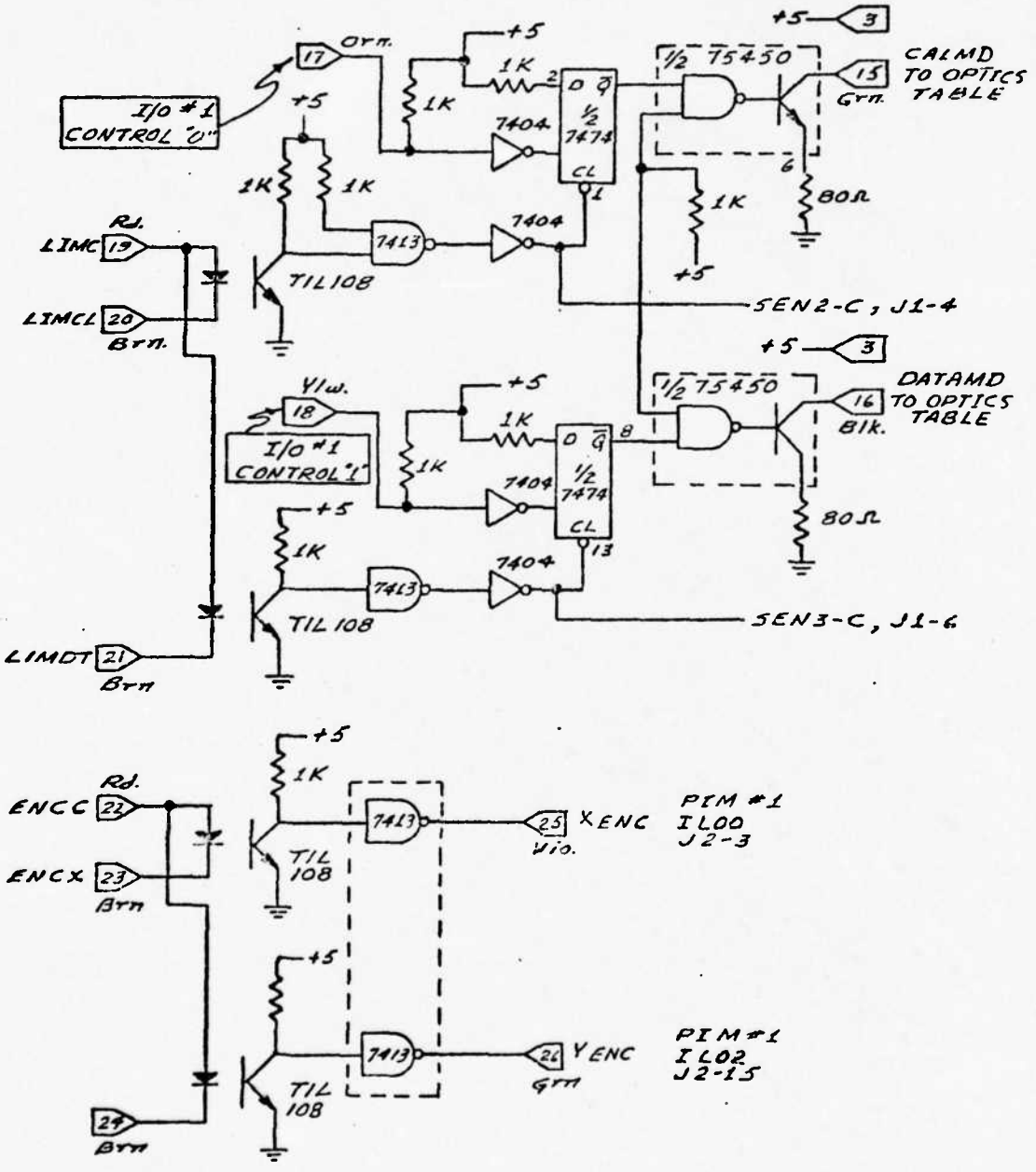
Plug-In Module, Slot #5 (Environmental Controls)



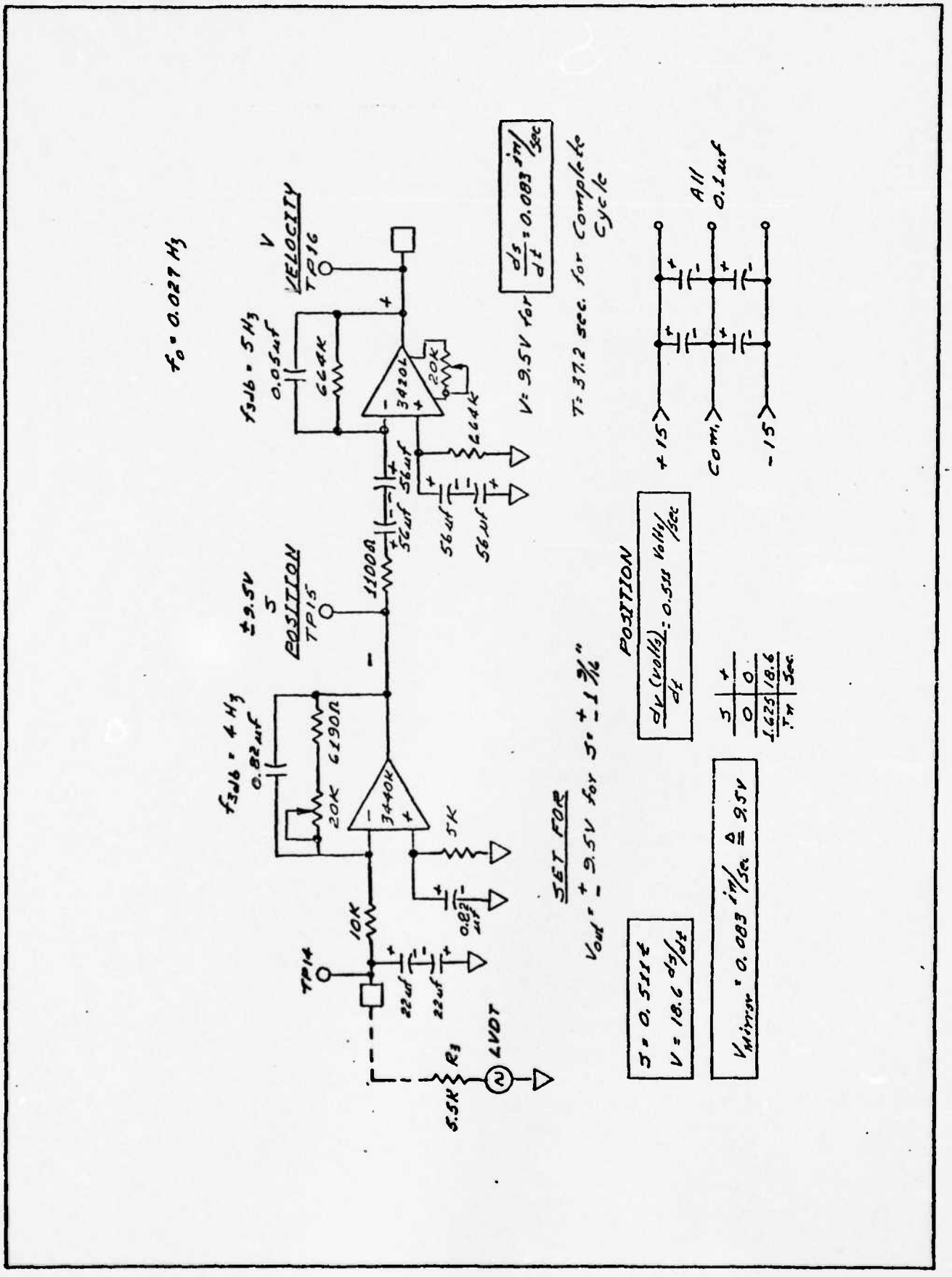
Warning Interfaces



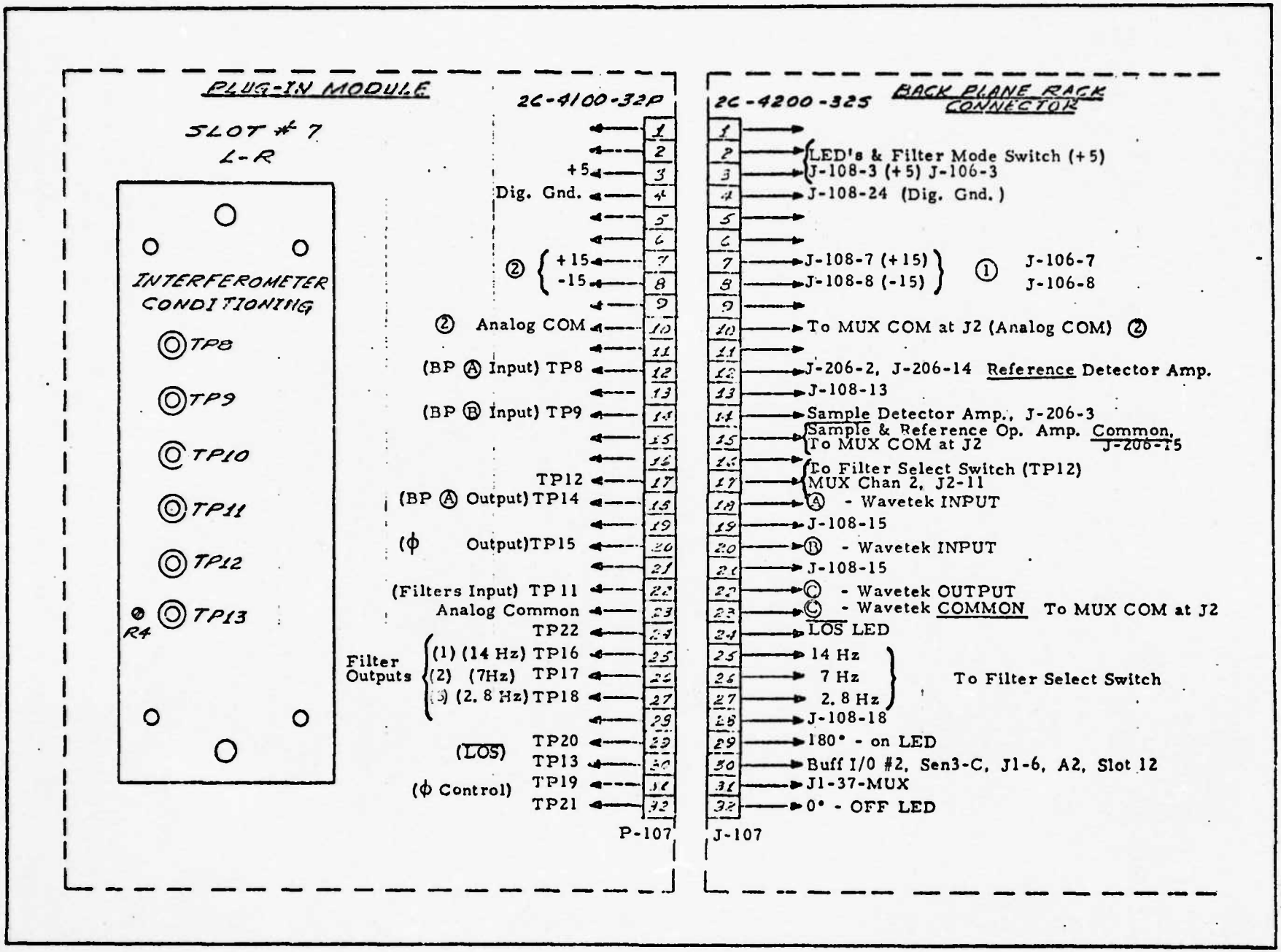
Plug-In Module, Slot #6 (Interferometer Doppler Mirror)



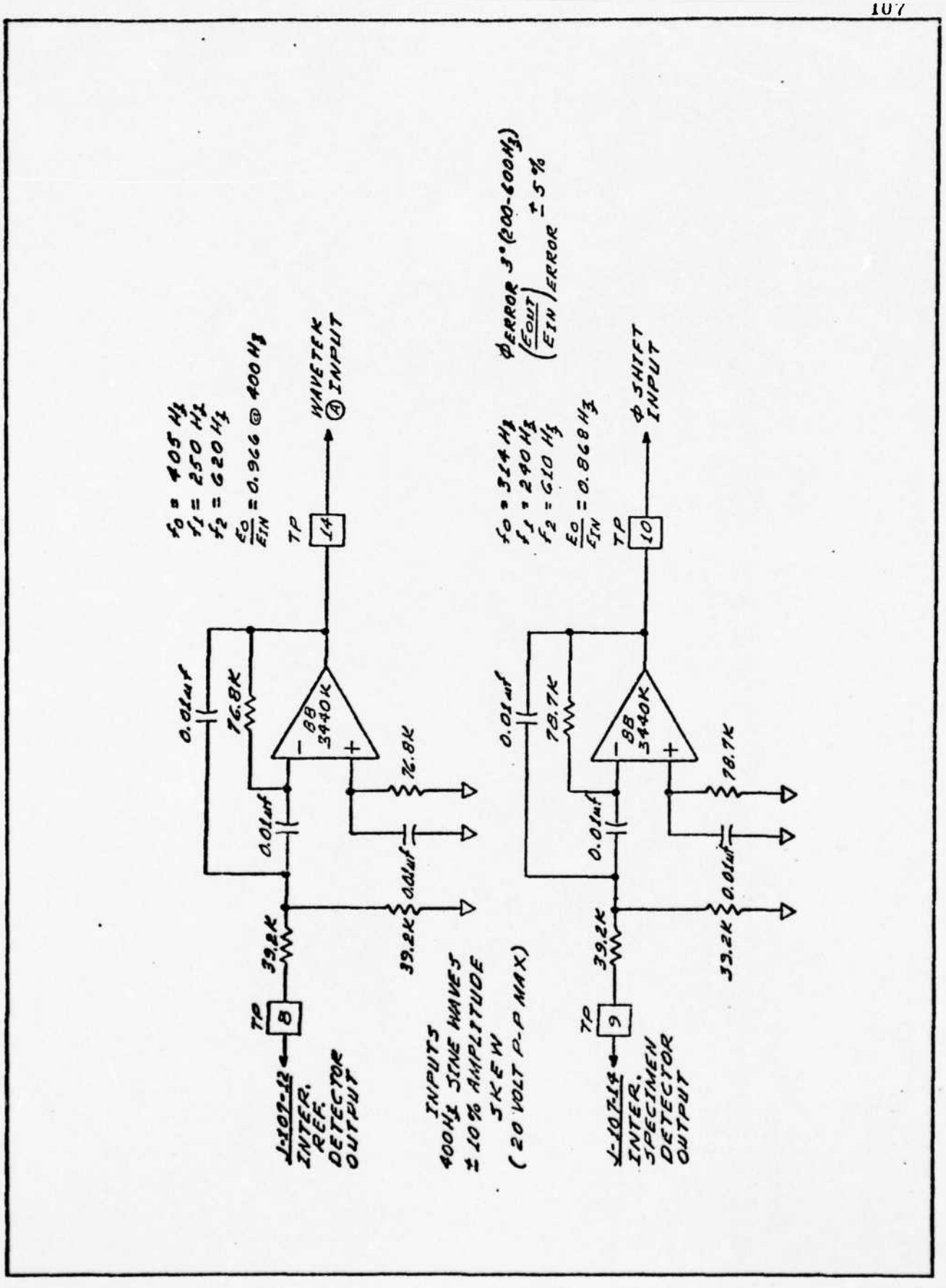
Vector Box, Slot #6 (Cal and Data Mode; X and Y Rack Encoders)



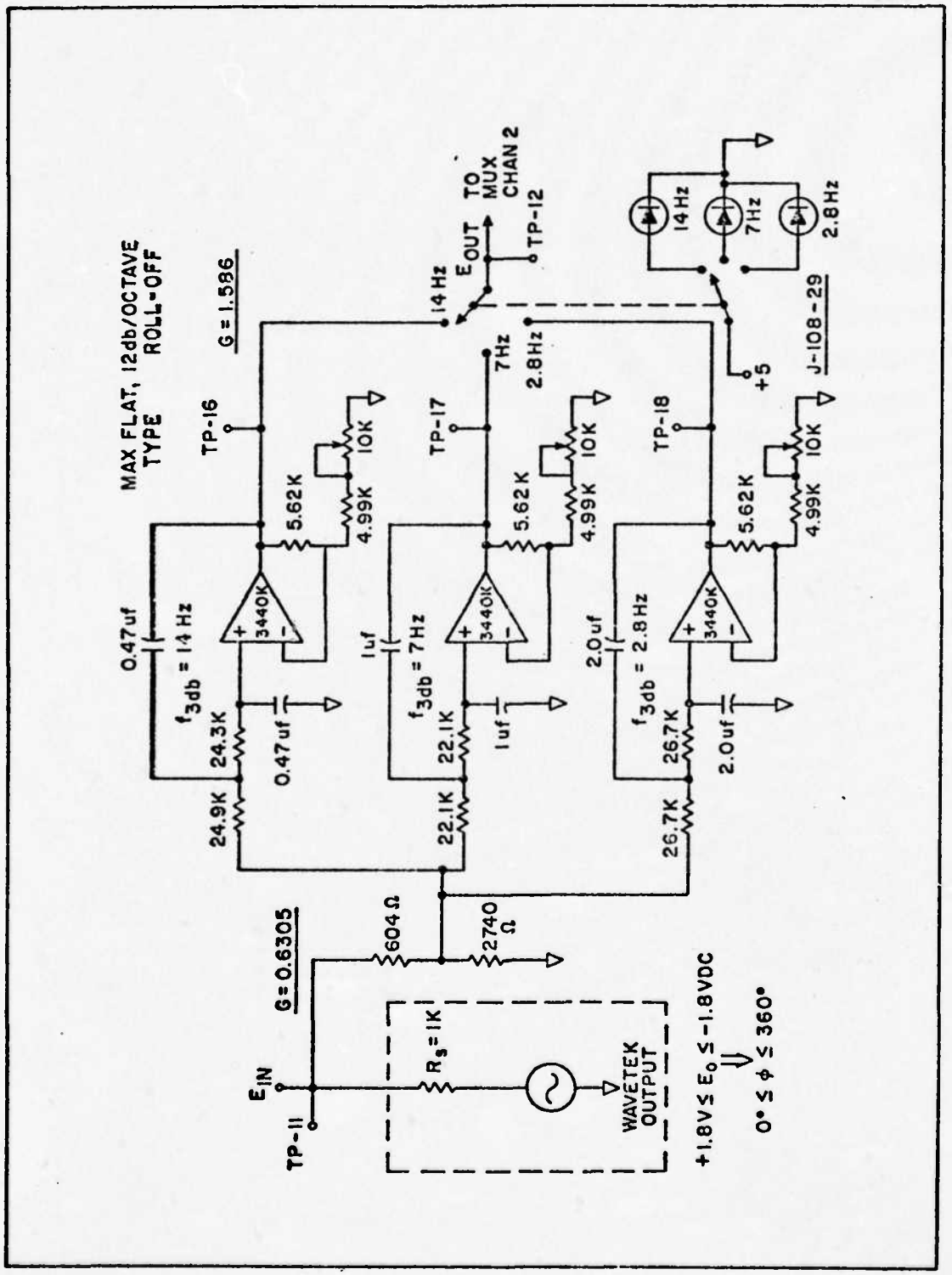
Doppler Mirror Position/Velocity Circuit



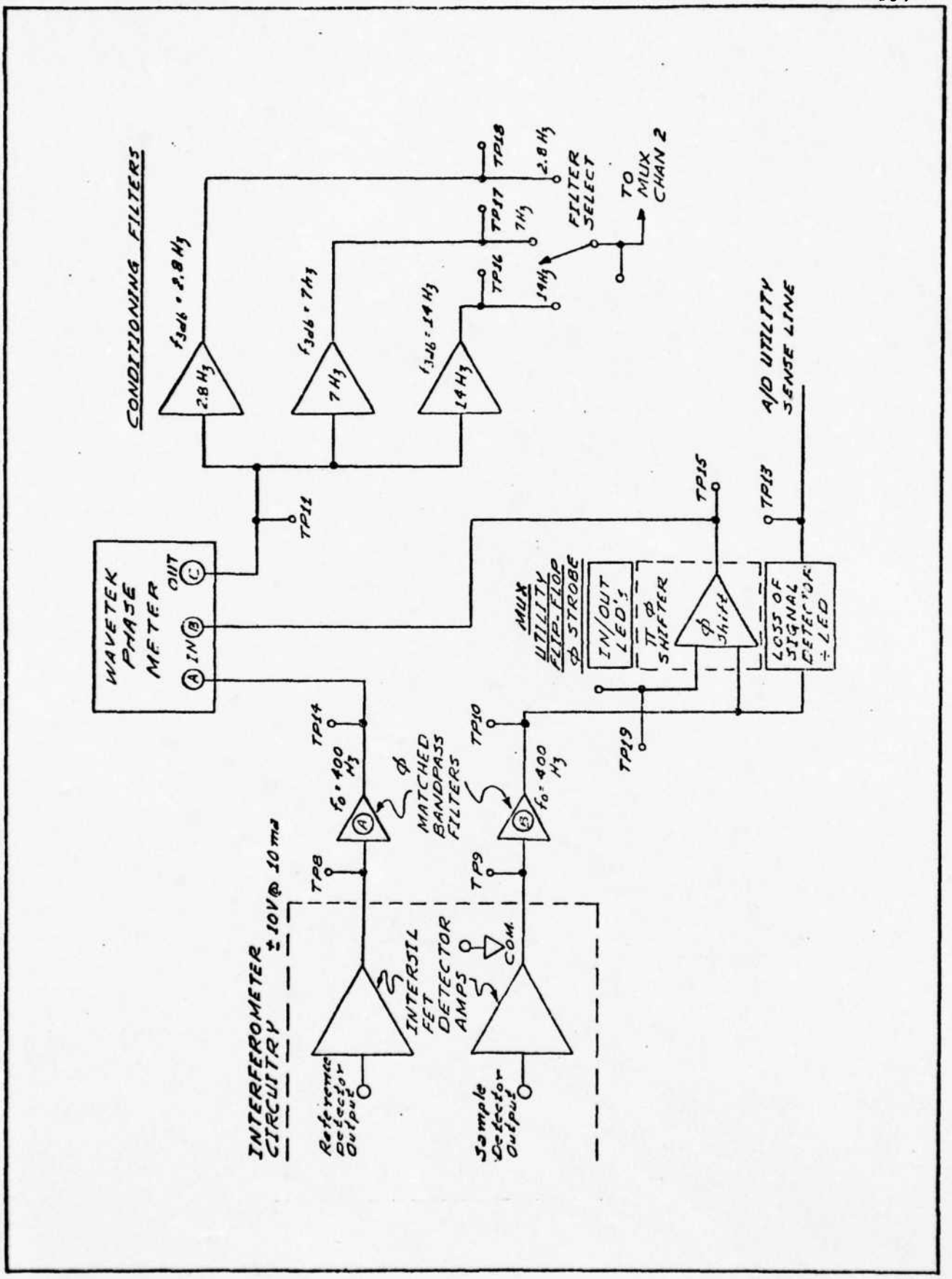
Plug-In Module, Slot #7 (Interferometer Signal Conditioning)



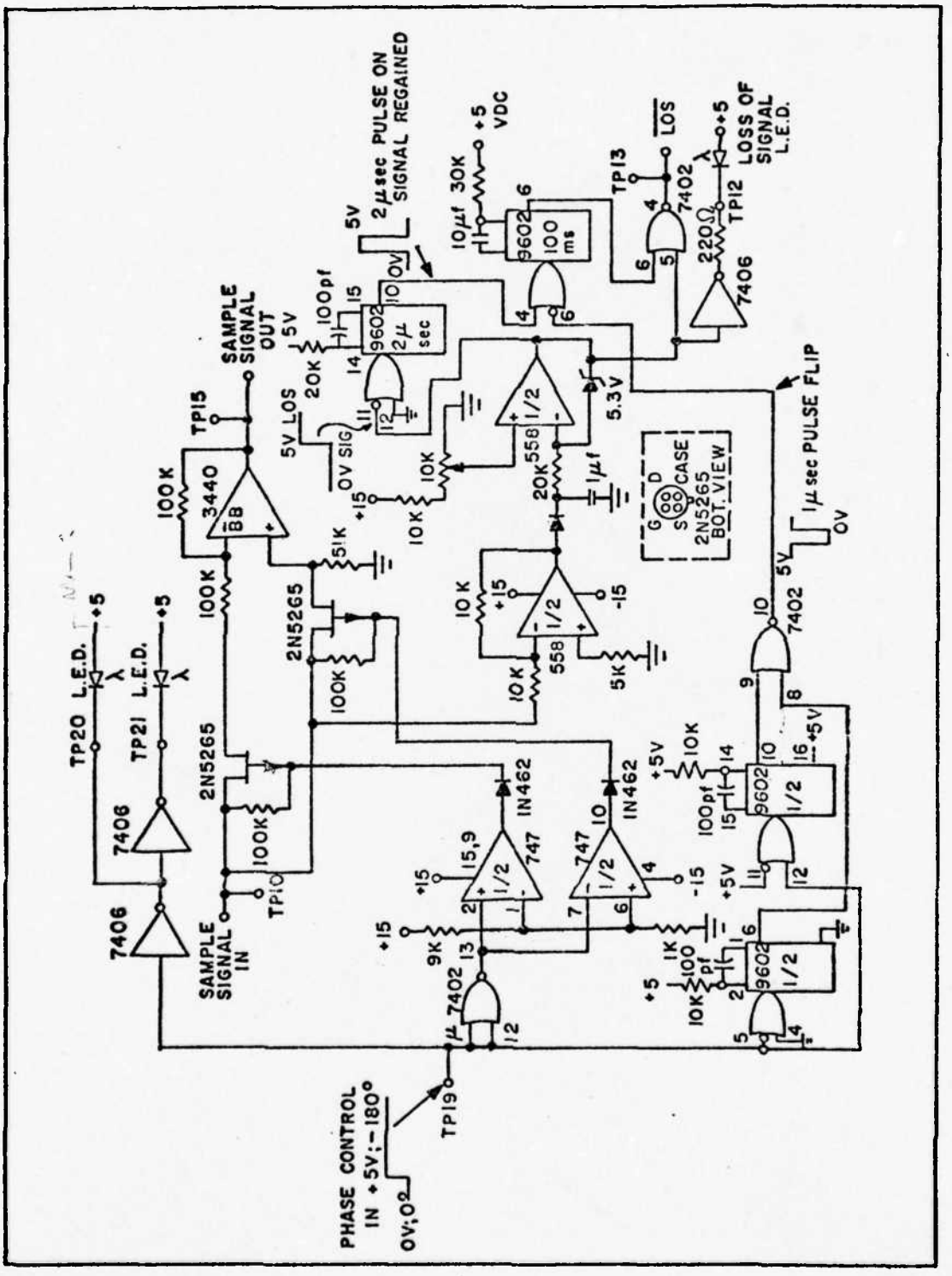
Phase-Matched Bank Pass Filters for Interferometer



Interferometer A/D Pre-Sample Filters



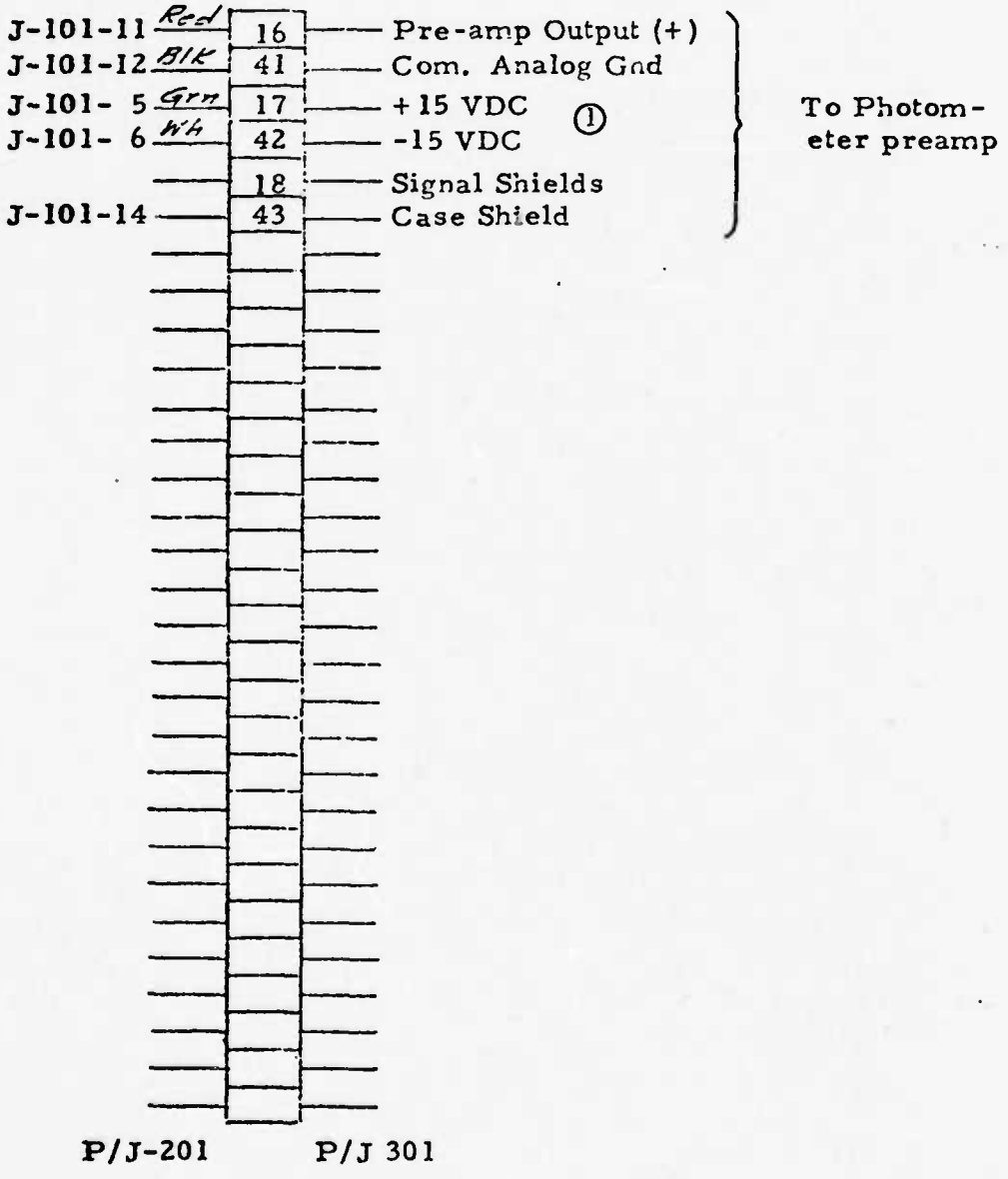
Interferometer Flow Diagram



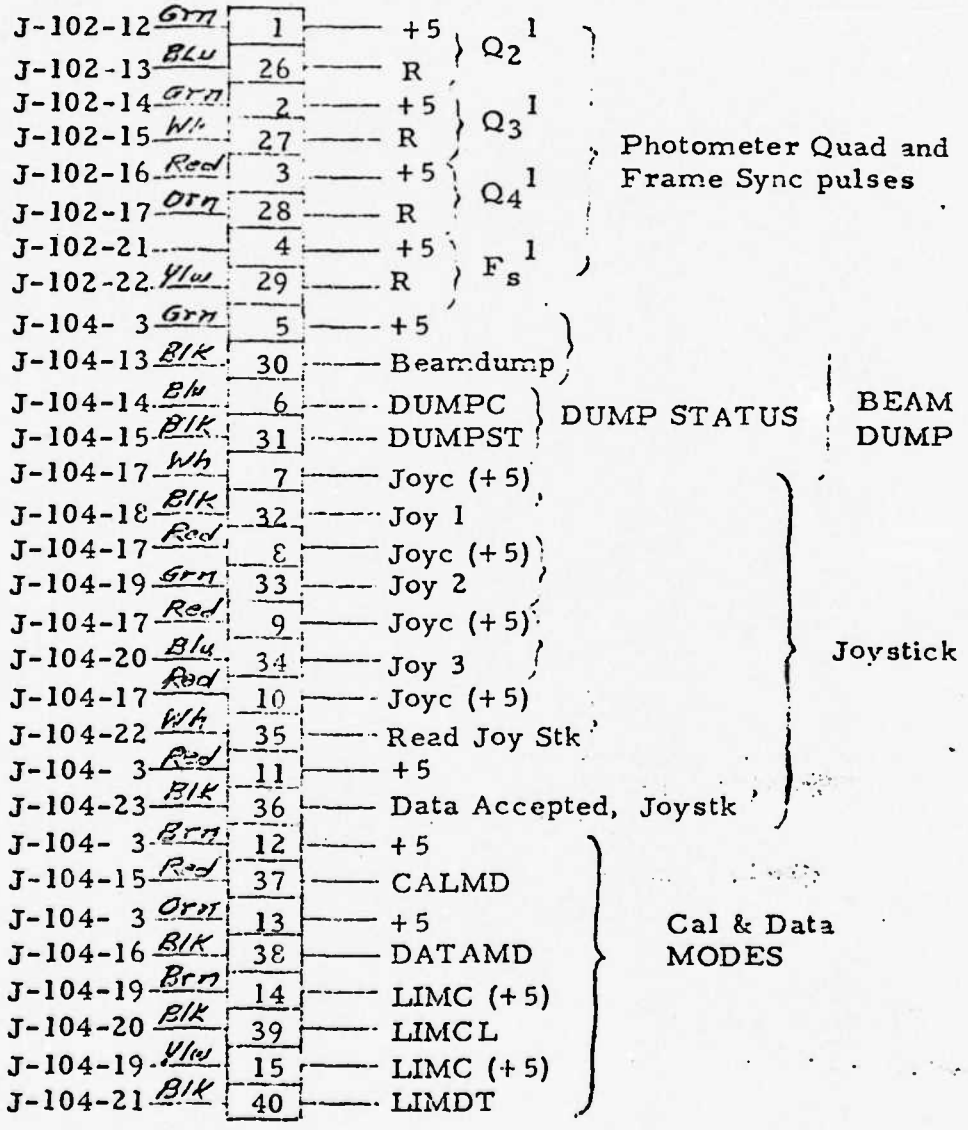
Interferometer Phase-Inverting Amplifier and Loss-of-Signal Detector

May 1975

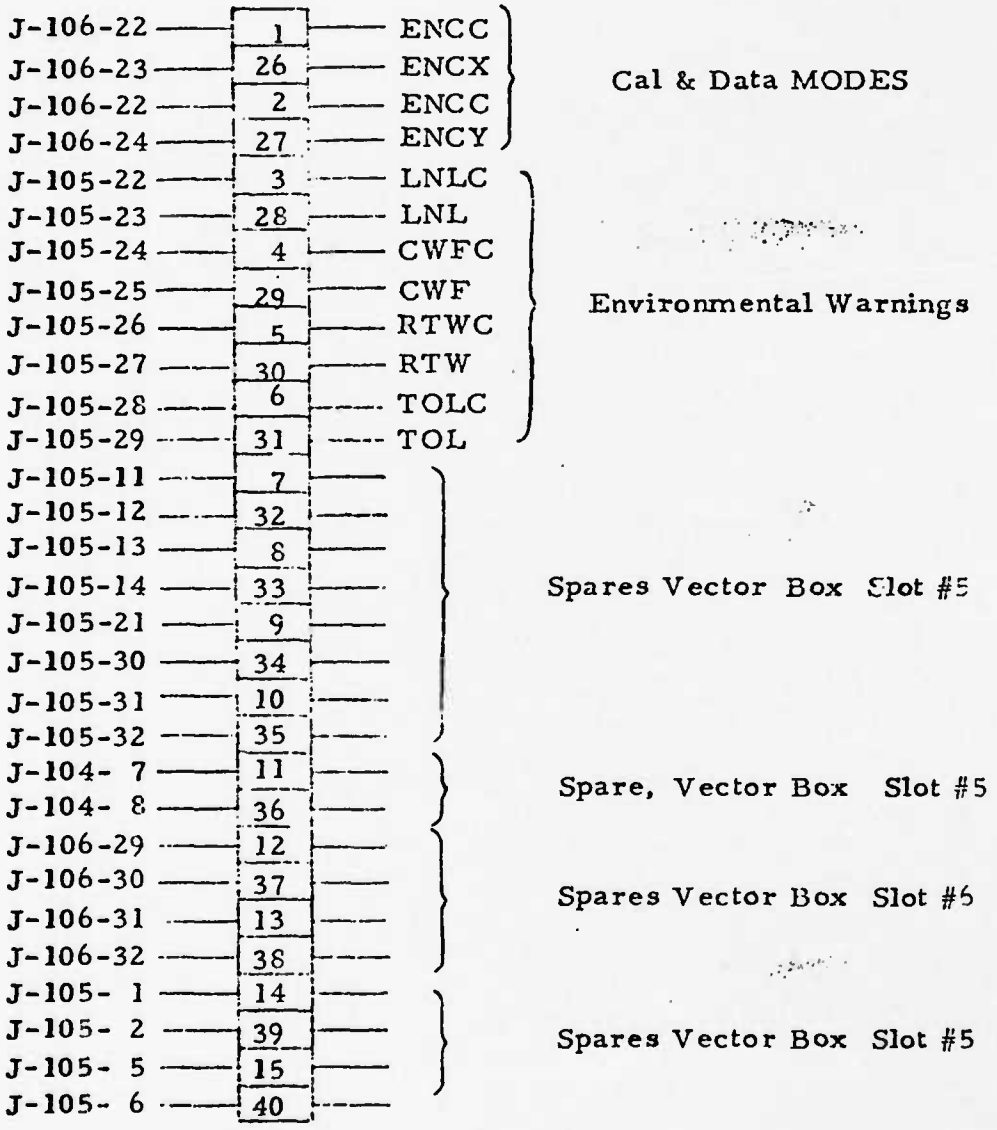
2.2 CONNECTIONS BETWEEN REAR PANEL OF CONSOLE AND CONNECTOR CHANNEL AT OPTICS TABLE (200 300 SERIES)



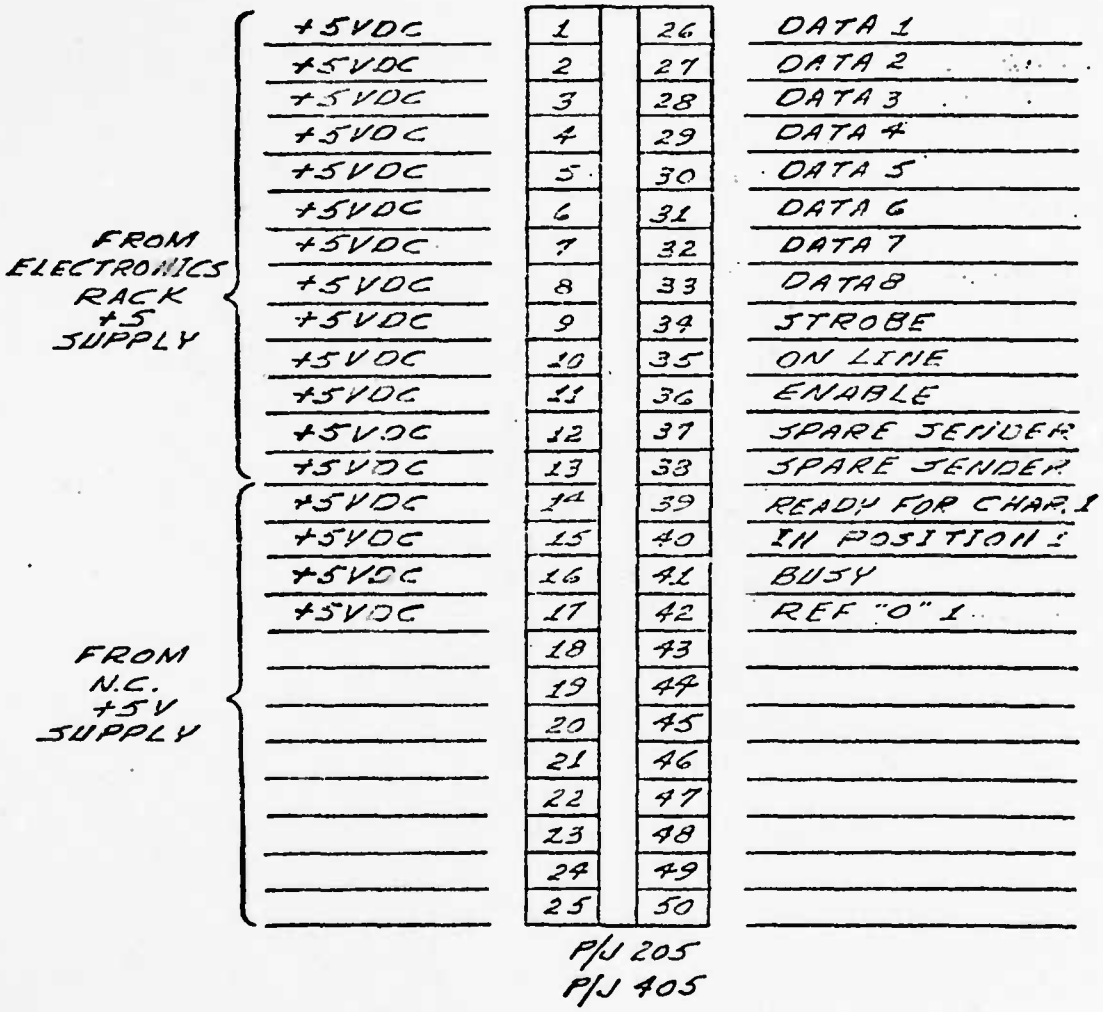
Console-to-Optics Table Connections (P/J 201, 301)



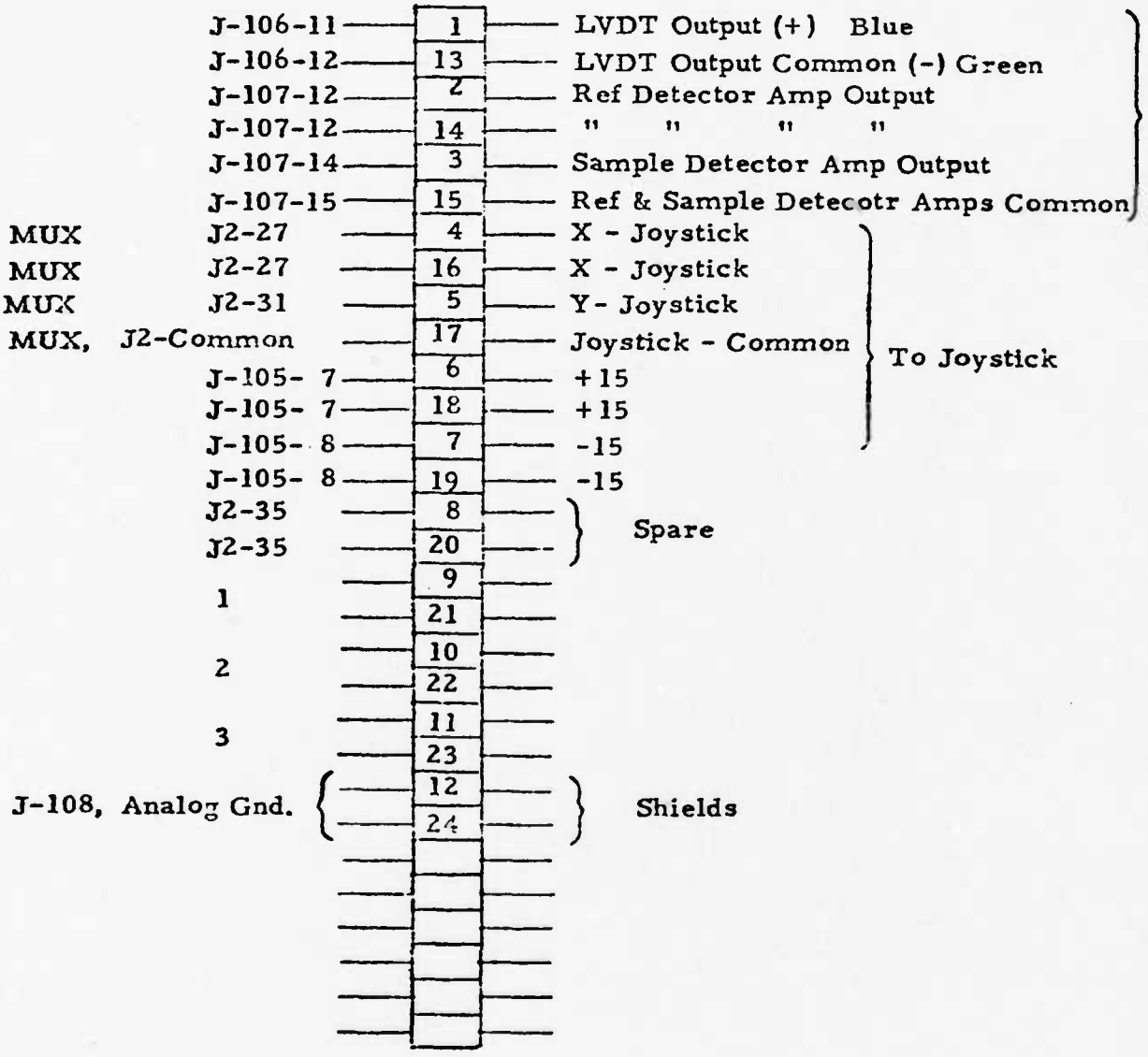
Console-to-Optics Table Connections (P/J 202, 302)



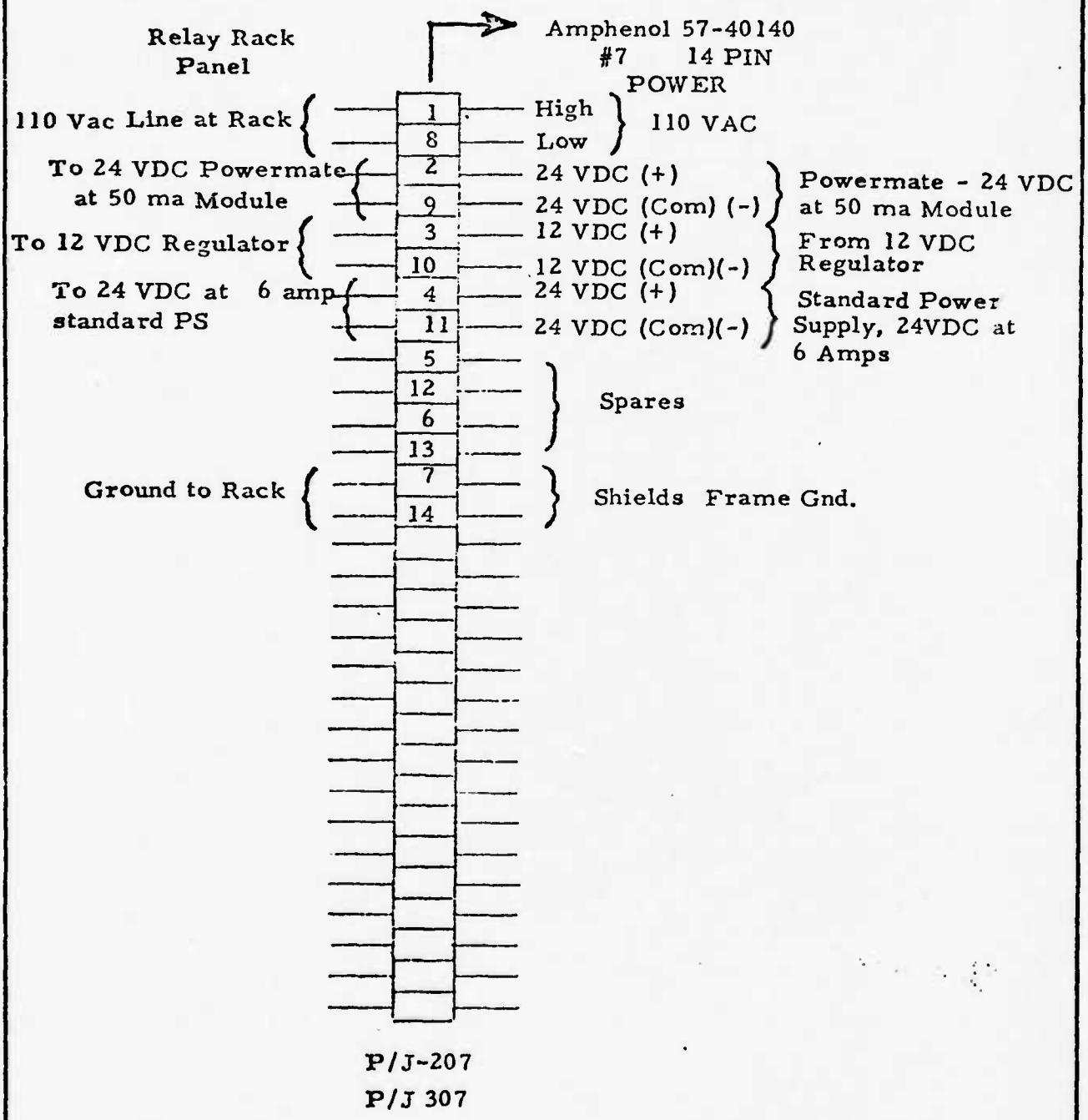
Console-to-Optics Table Connections (P/J 203, 303)



Console-to-Numerical Control Connections (P/J 205, 405)

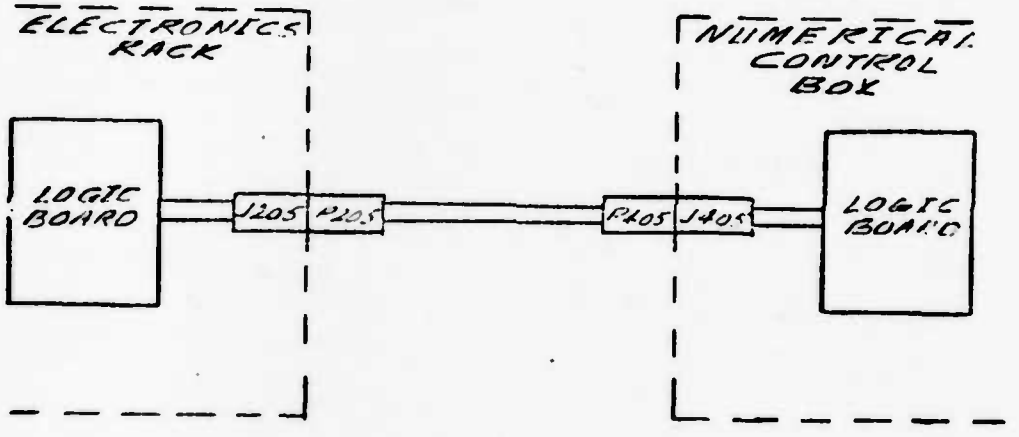


Console-to-Optics Table Connections (P/J 206, 306)

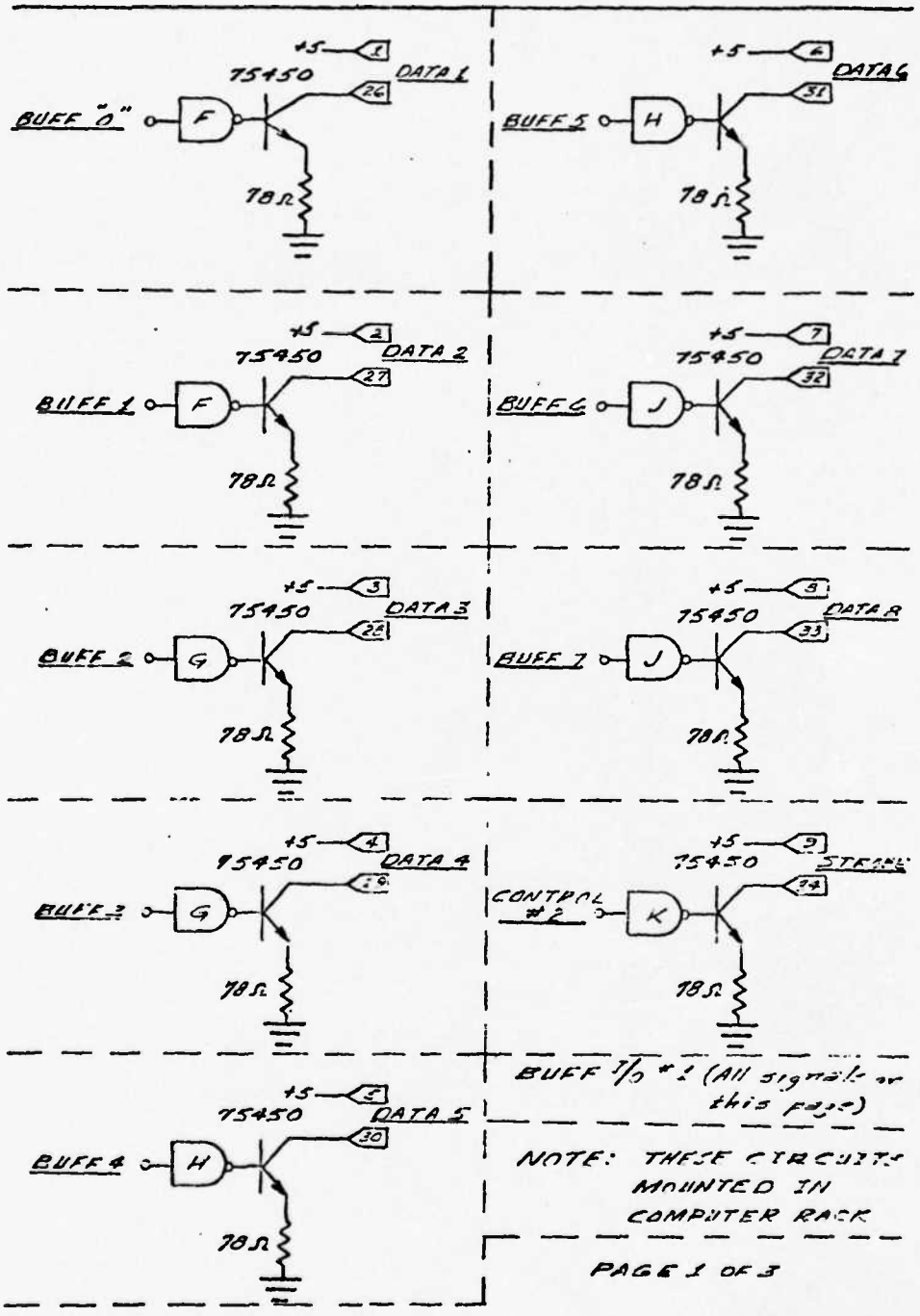


Console-to-Optics Table Connections (P/J 207, 307)

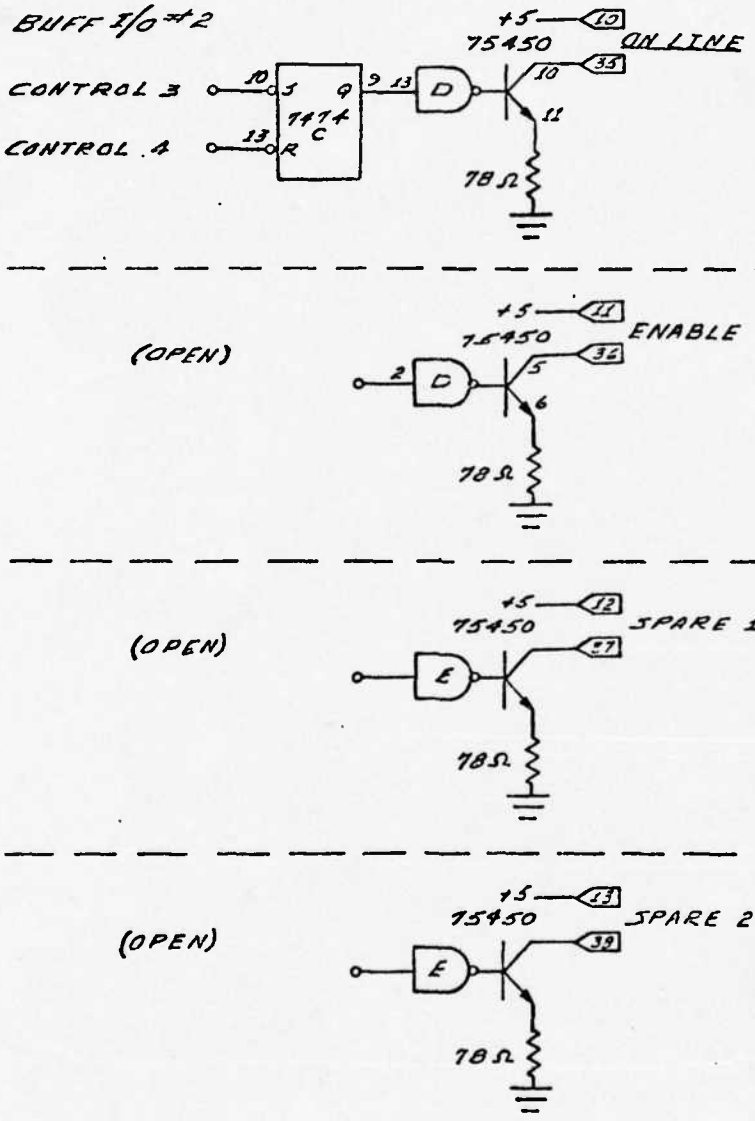
2.3 NUMERICAL CONTROLLER (400 SERIES)



Numerical Control Wiring Block Diagram



Numerical Control Data Transmitters



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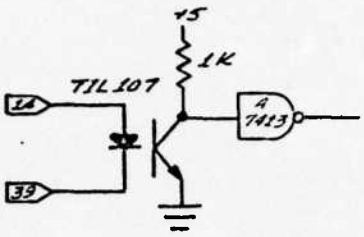
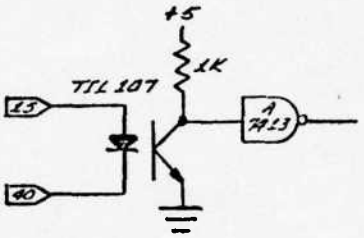
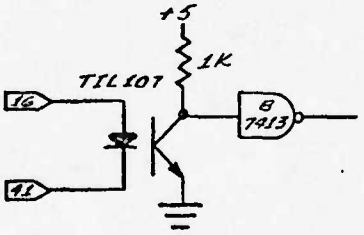
PAGE 2 OF 3



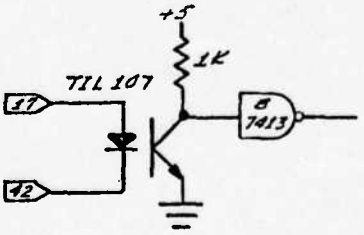
NUMERICAL CONTROL
READY FOR CHARACTER
BUFF I/O #1 SENSE LINE 7



NUMERICAL CONTROL
IN POSITION
BUFF I/O #1 SENSE LINE 1



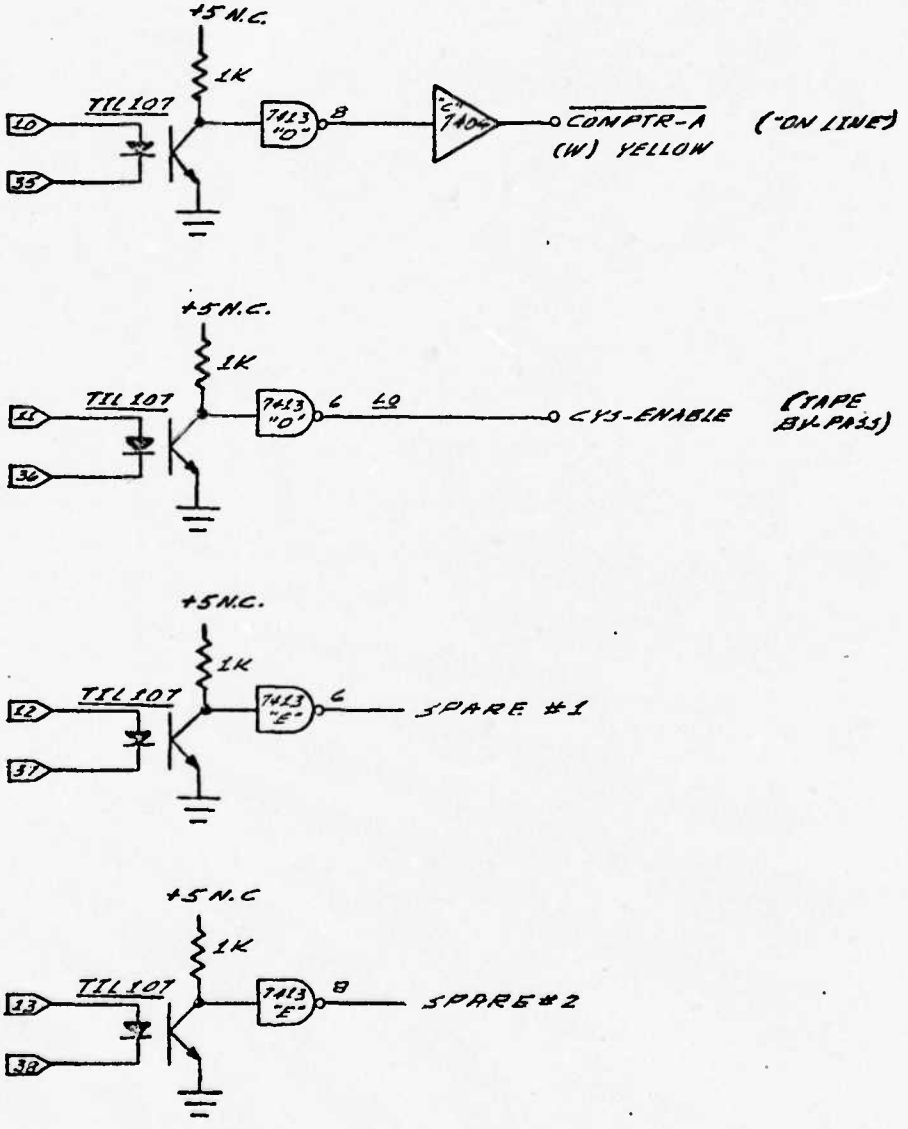
BUSY
(OPEN)
LOW WHEN CYCLING



$\overline{\text{REF 0}}$

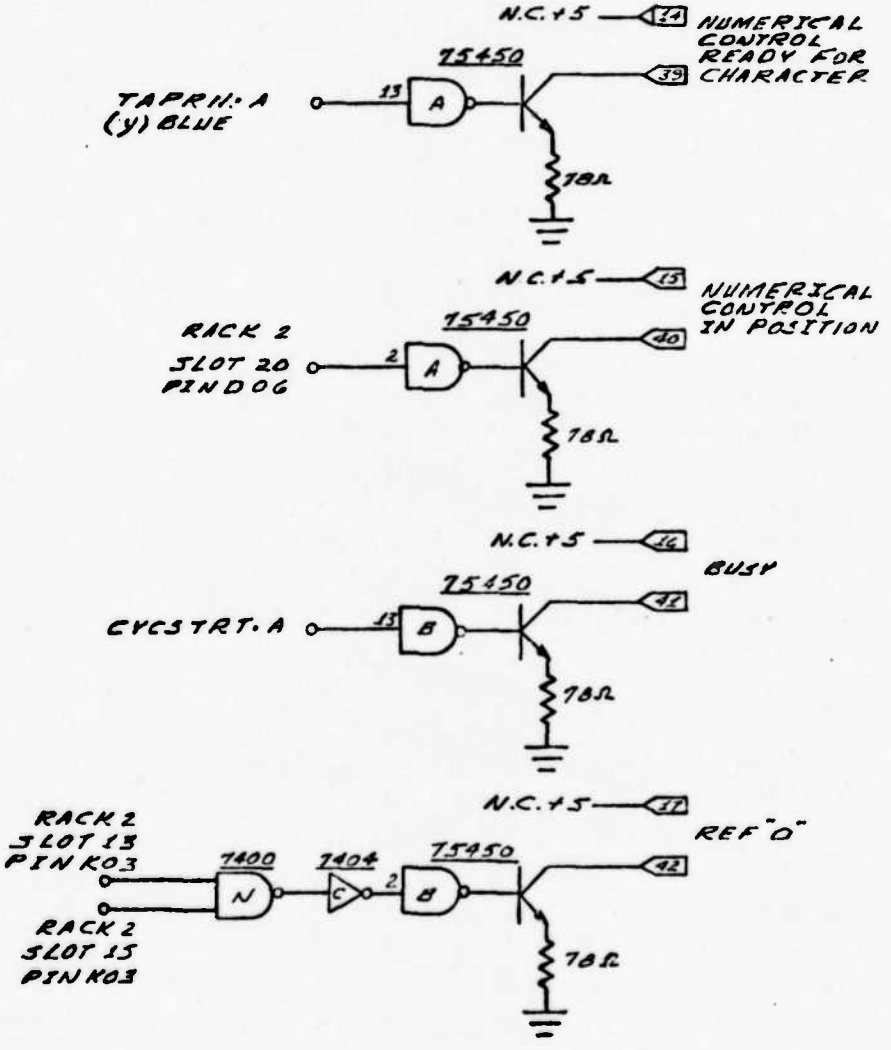
MOUNTED IN RACK
PAGE 3 of 3

Logic Board in N.C. Box 1 of 3

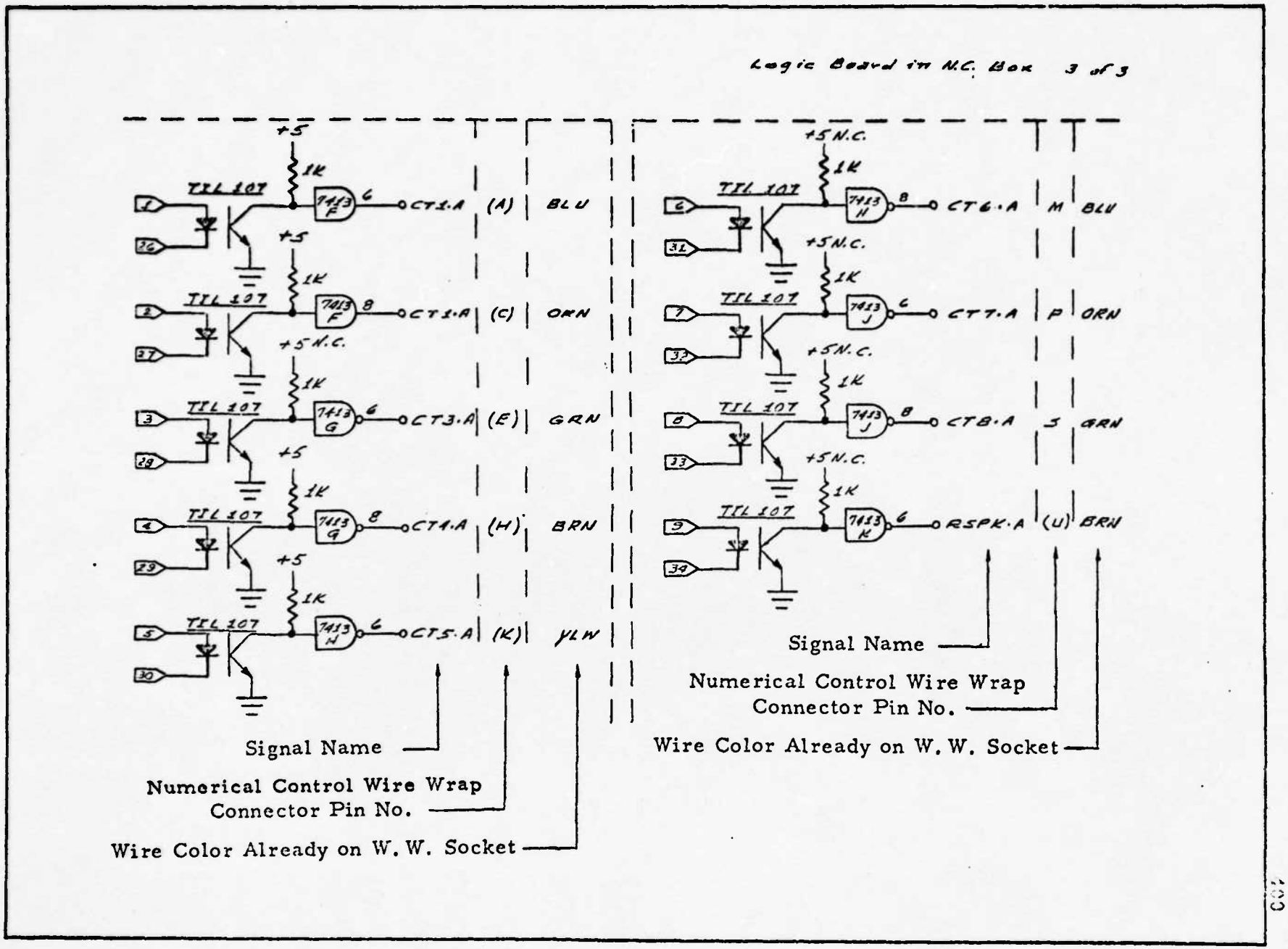


NOTE: These circuits are mounted inside the G.E. numerical control box.
The 5-volt connections are the G.E. power supply.
(X) indicates wire wrap connector of numerical controller.

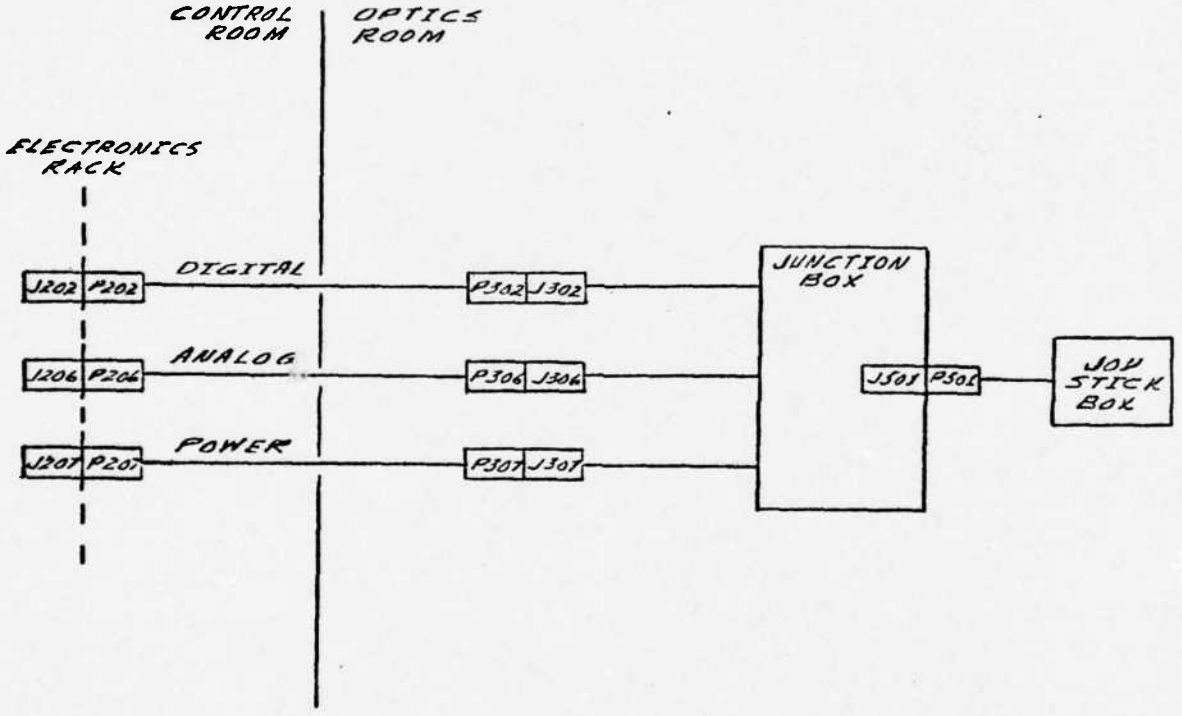
Logic Board in N.C. Box 2 of 3



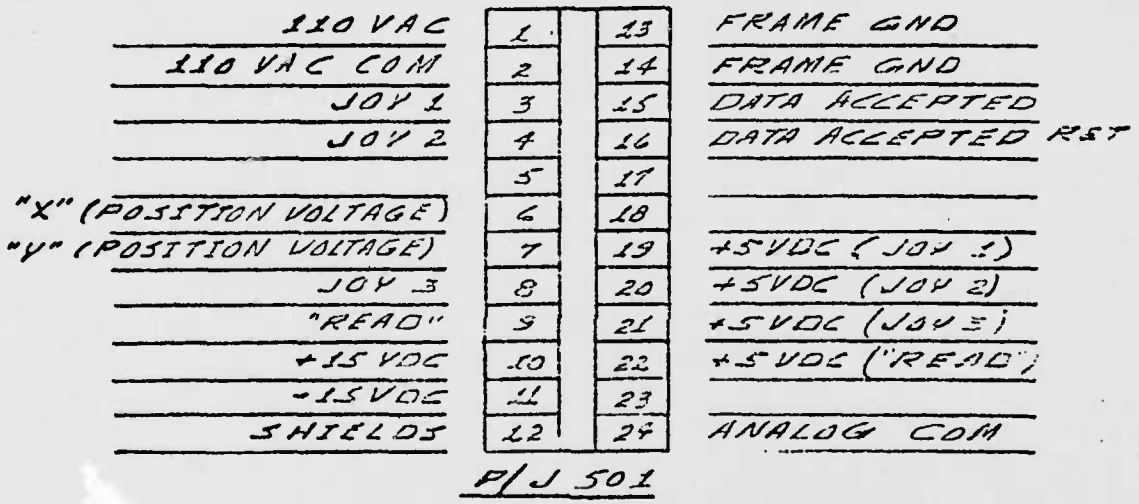
Numerical Control Status Responses


Logic Board in N.C. Box 3 of 3
+5
1K
TTL 107
7413 F
CT1·A
(A)
BLU
+5
1K
TTL 107
7413 F
CT1·A
(C)
ORN
+5 N.C.
1K
TTL 107
7413 G
CT3·A
(E)
GRN
+5
1K
TTL 107
7413 G
CT4·A
(H)
BRN
+5
1K
TTL 107
7413 N
CT5·A
(K)
YLW
+5 N.C.
1K
TTL 107
7413 H
CT6·A
M
BLU
+5 N.C.
1K
TTL 107
7413 J
CT7·A
P
ORN
+5 N.C.
1K
TTL 107
7413 J
CT8·A
S
GRN
+5 N.C.
1K
TTL 107
7413 K
RSPK·A
(U)
BRN
Signal Name
Numerical Control Wire Wrap Connector Pin No.
Wire Color Already on W. W. Socket
Signal Name
Numerical Control Wire Wrap Connector Pin No.
Wire Color Already on W. W. Socket

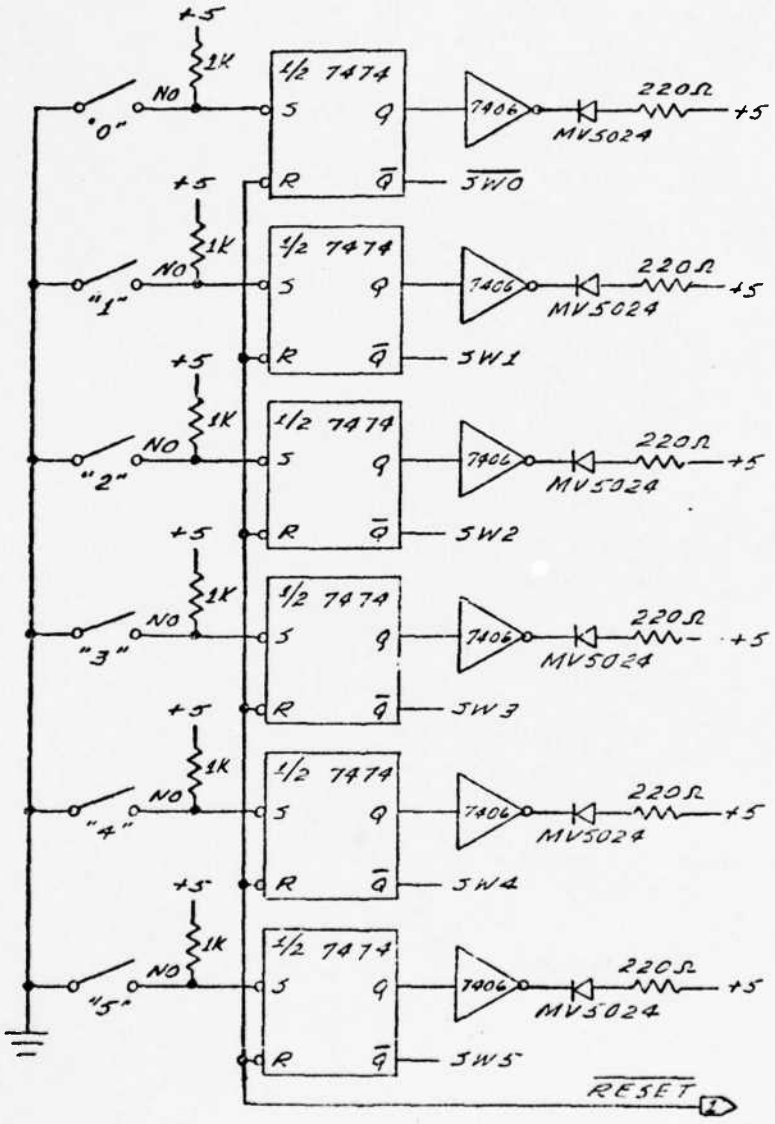
2.4 JOYSTICK (500 SERIES)



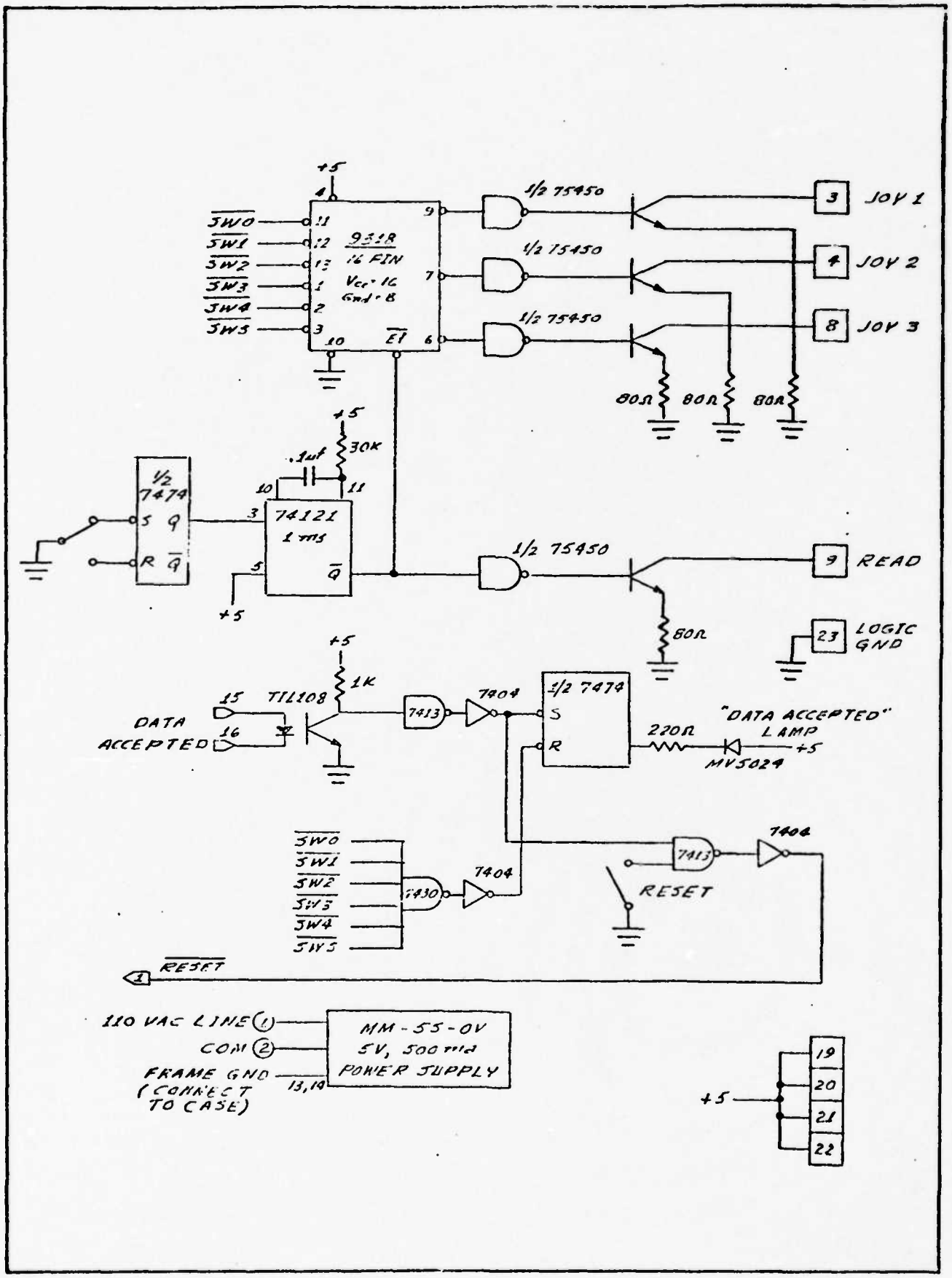
Joystick Wiring Block Diagram



Connector at Joystick Cable Junction Box



Joystick Digital Portion (Inside Joystick Box) Sheet 1 of 2



Joystick Digital Portion (Inside Joystick Box) Sheet 2 of 2

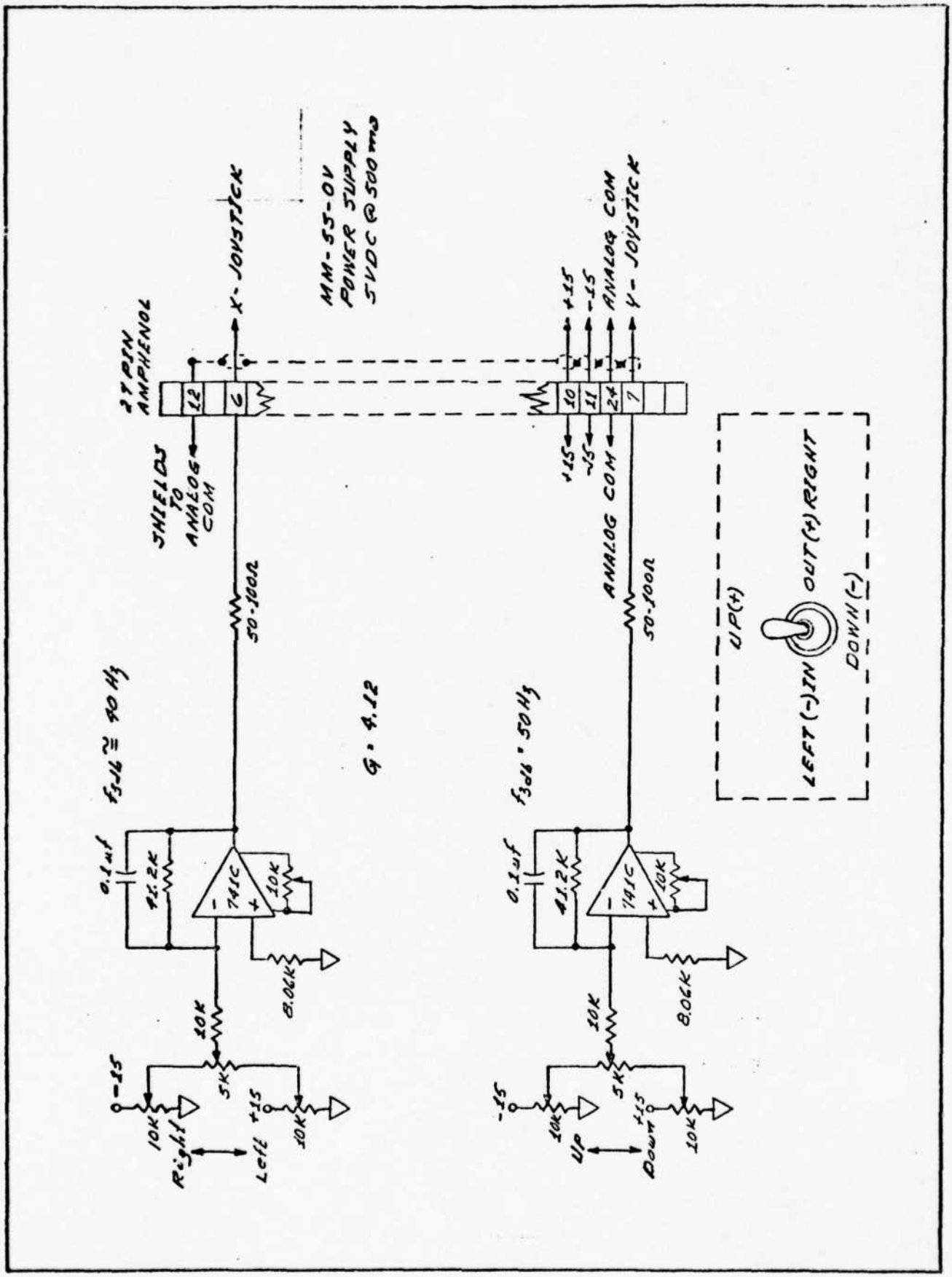
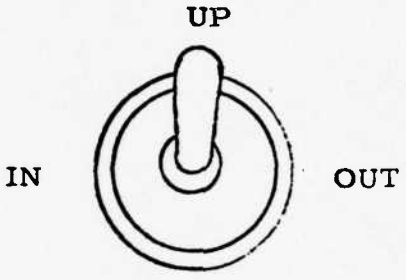


Fig. 4.12

Joystick Control

JOYSTICK LEGEND



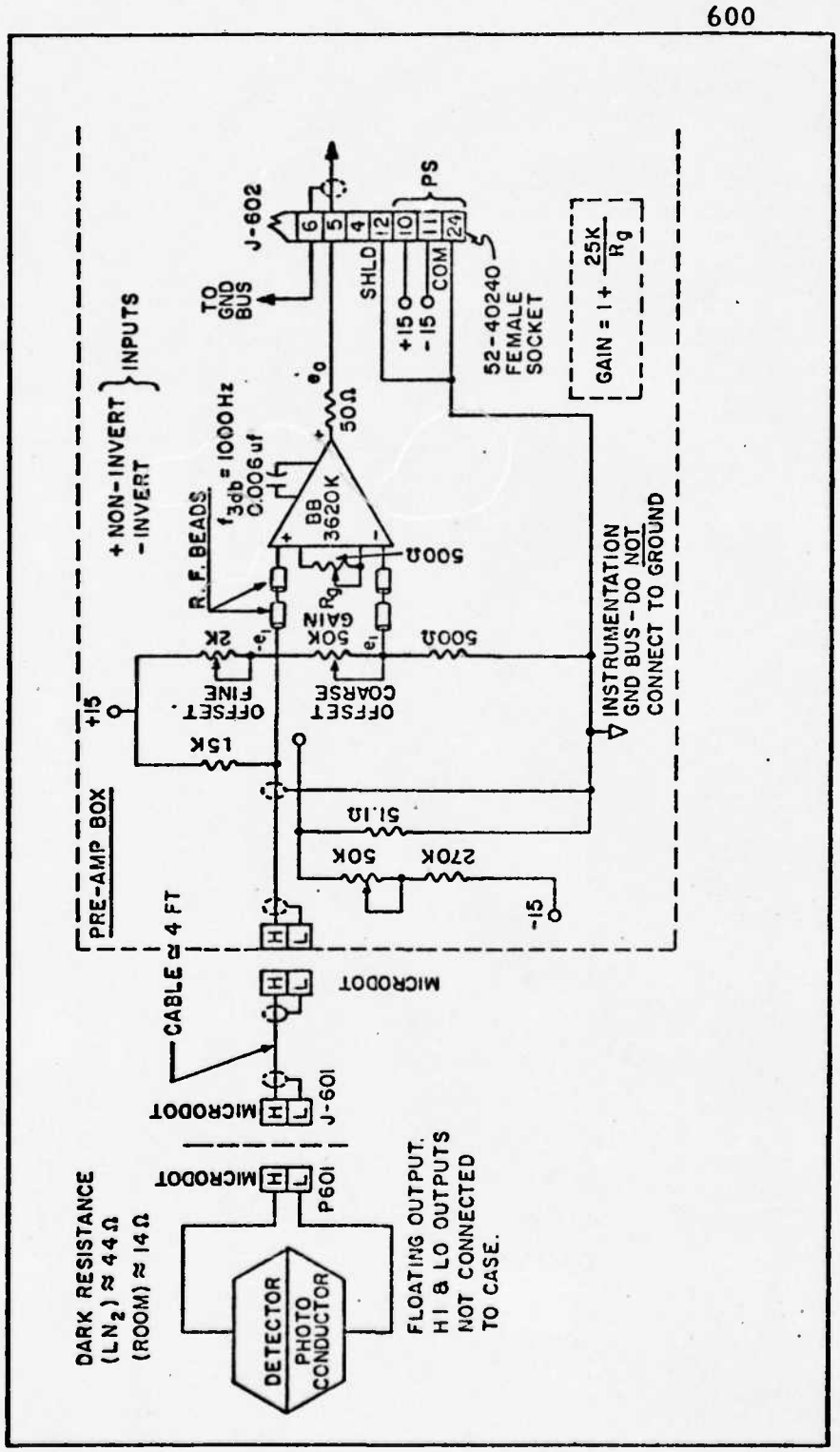
In/Out of table slot

FULL SCALE OUTPUTS

UP +9.5 V	In -9.5 V
DOWN -9.5 V	Out +9.5 V

Joystick Legend

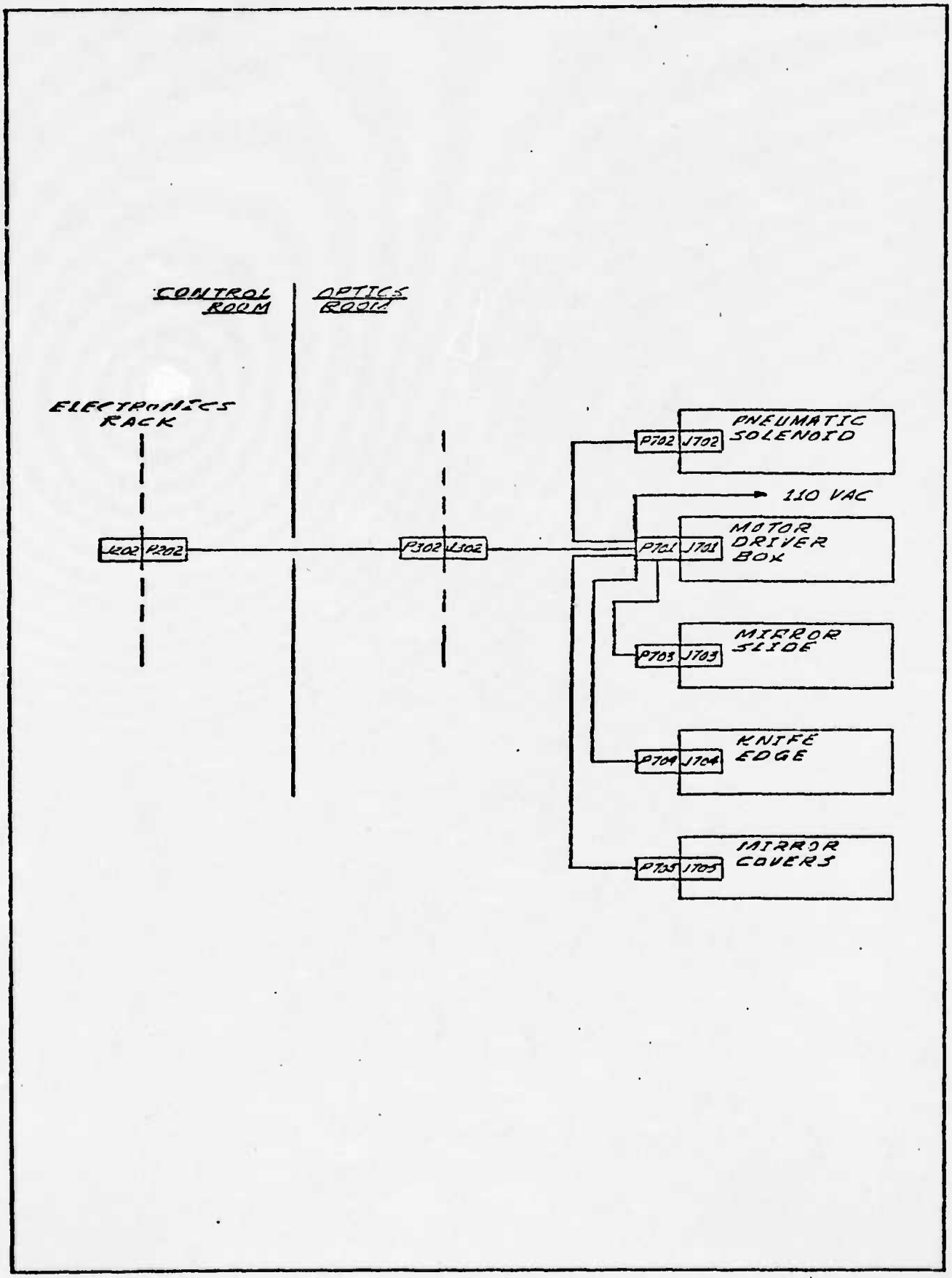
2.5 PHOTOMETER PREAMPLIFIER (600 SERIES)



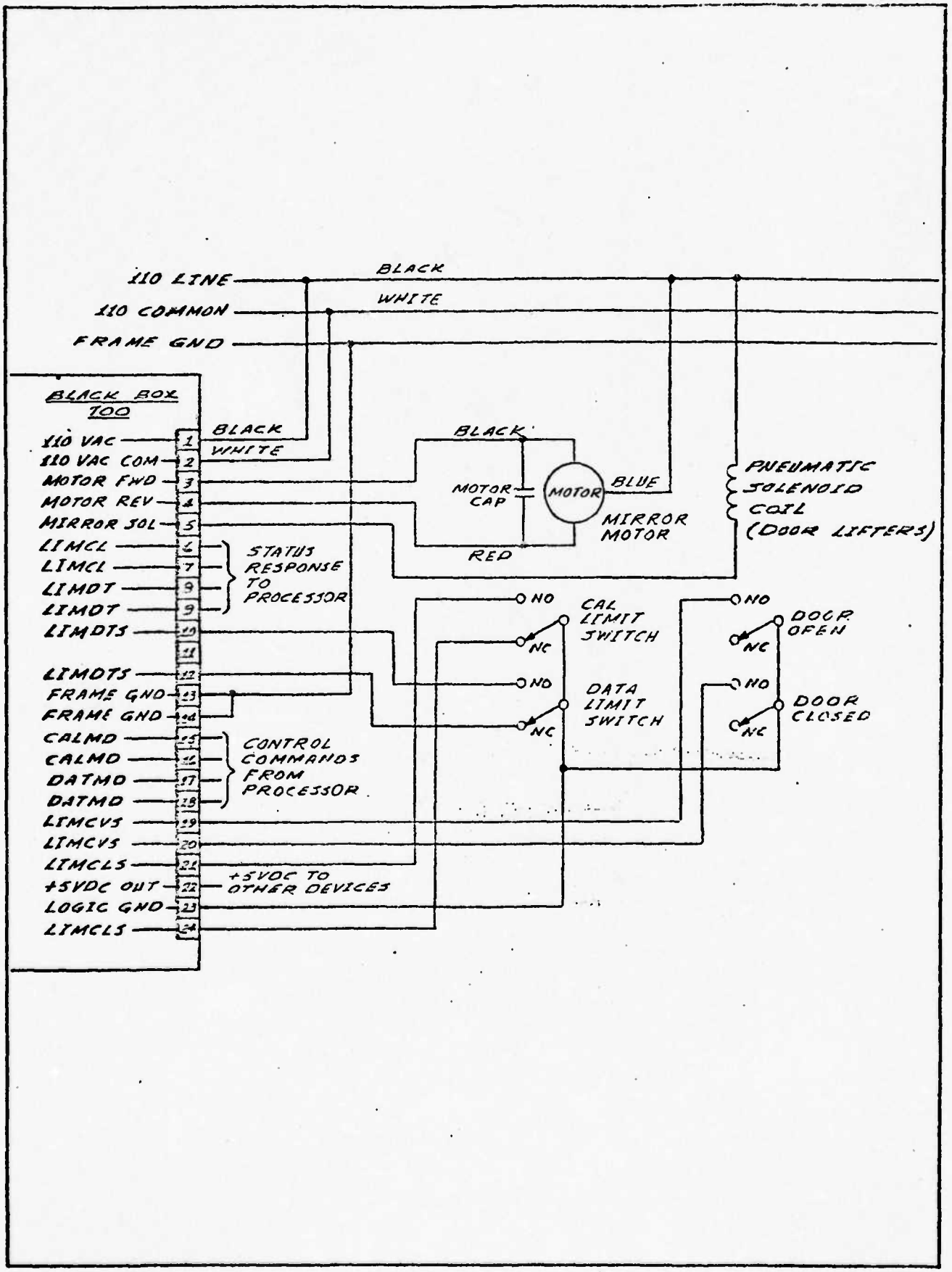
Photometer Preamplifier

May 1975

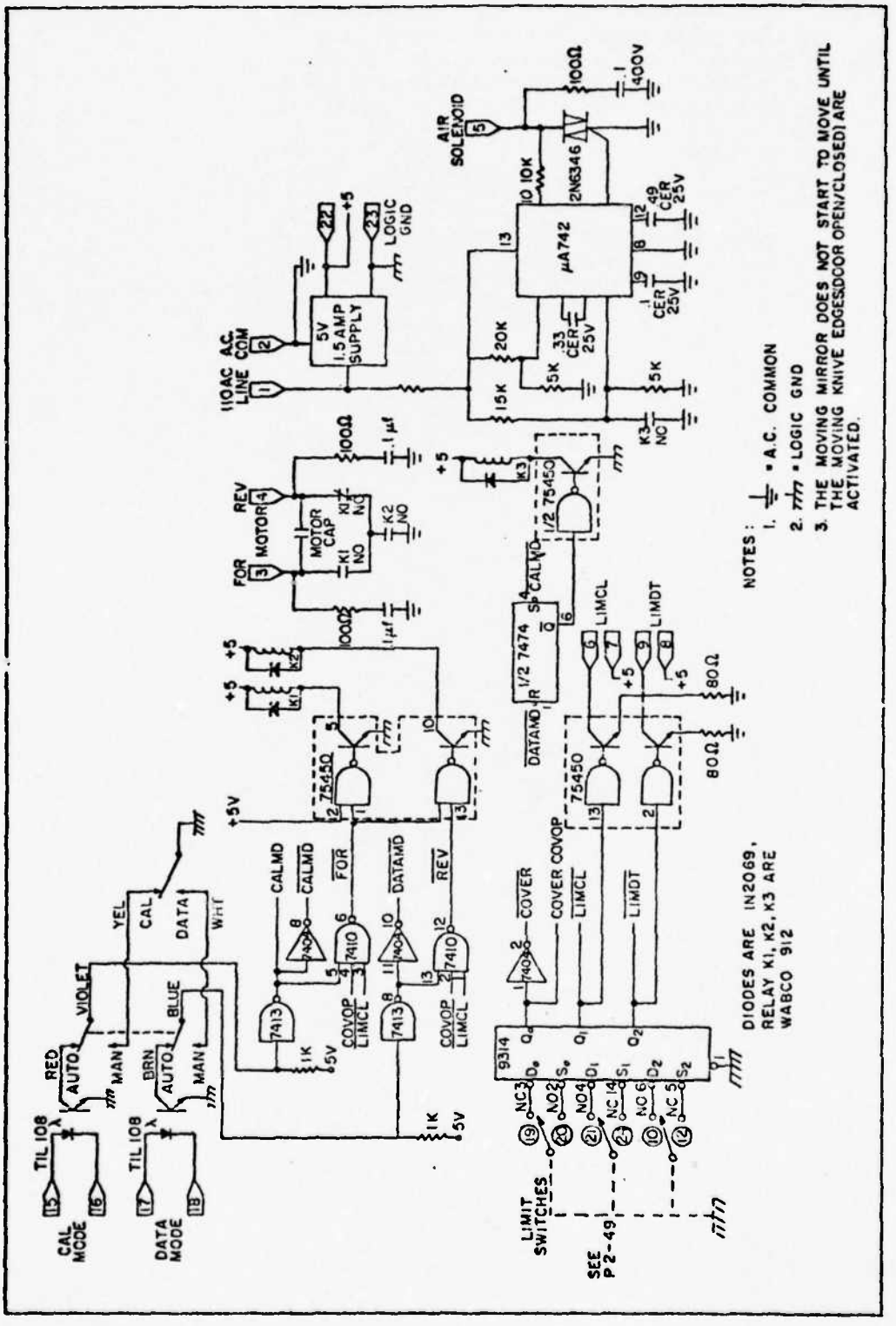
2.6 PHOTOMETER CALIBRATION MIRROR CIRCUITRY (700 SERIES)



Calibration Mirrors Wiring Block Diagram

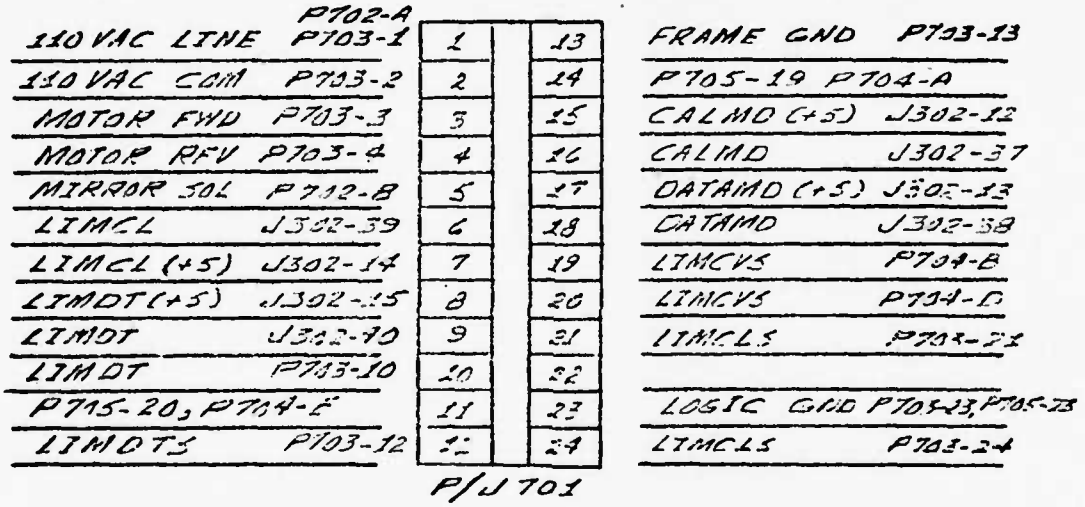


Photometer Calibration Mirror System Wiring



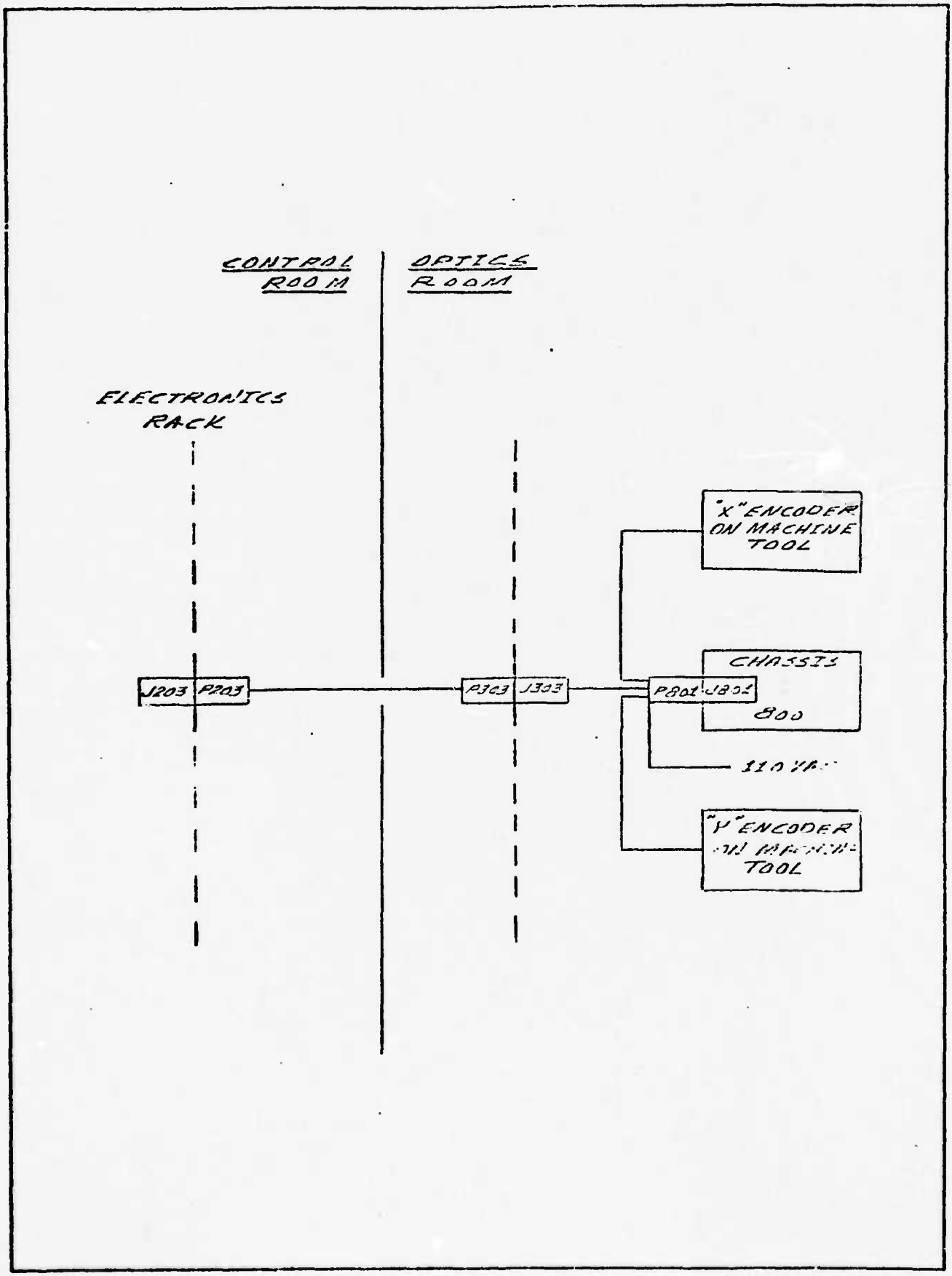
Mirror and Door Driver Circuit (Optics Room)

May 1975

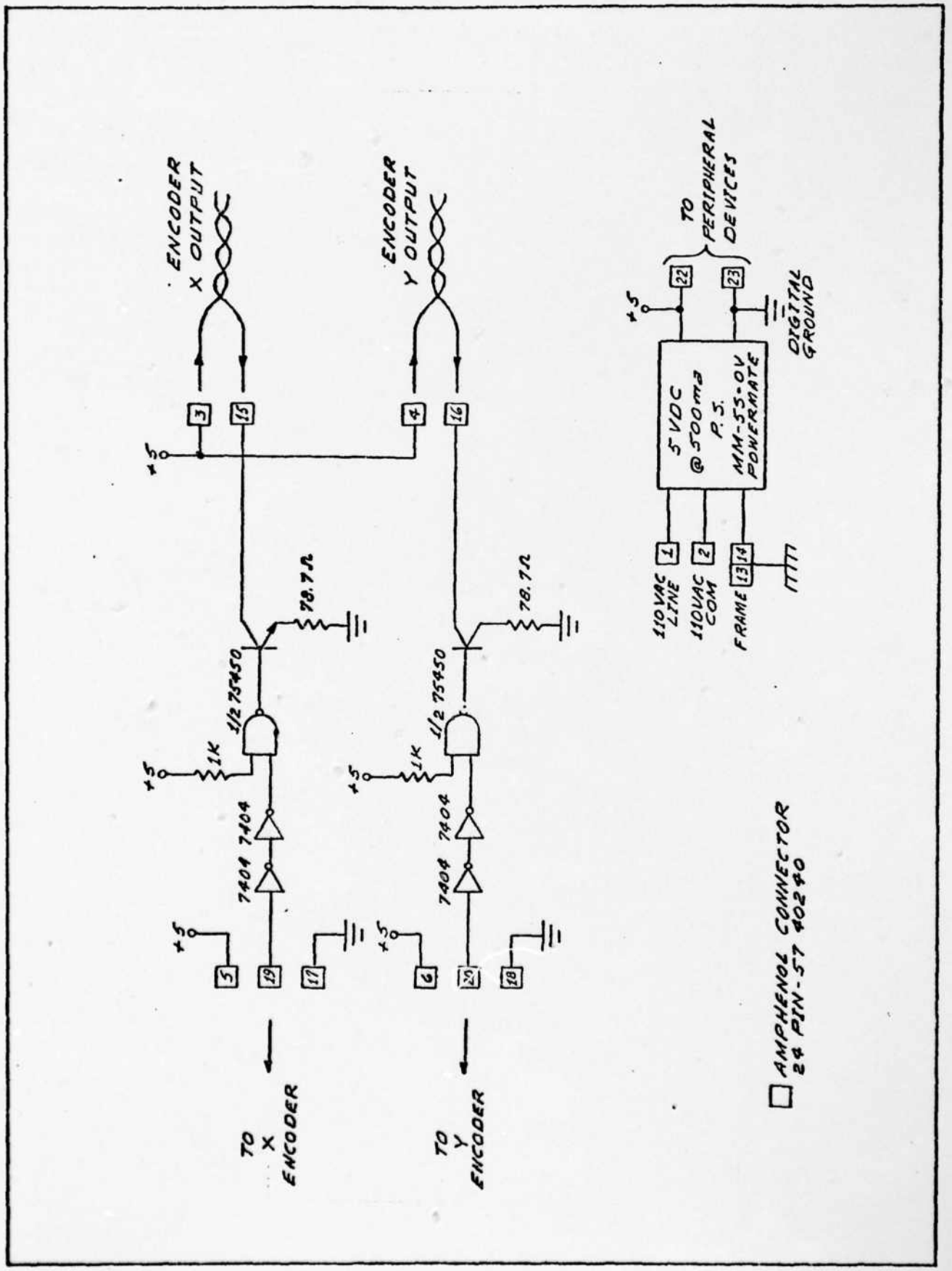


Connector at Calibrate Mirror Control Box

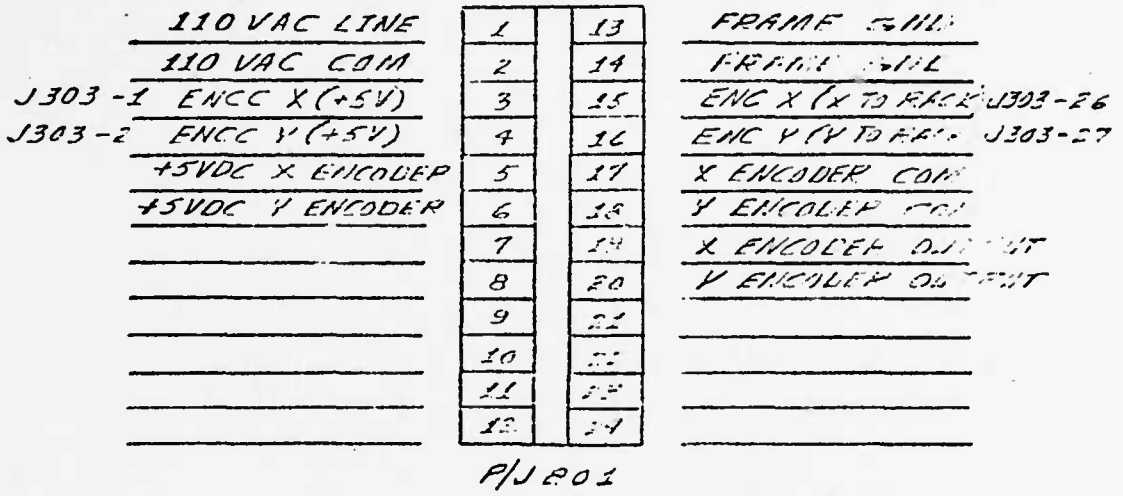
2.7 INTERFEROMETER X-Y ENCODERS (800 SERIES)



Interferometer X-Y Encoder Wiring Block Diagram

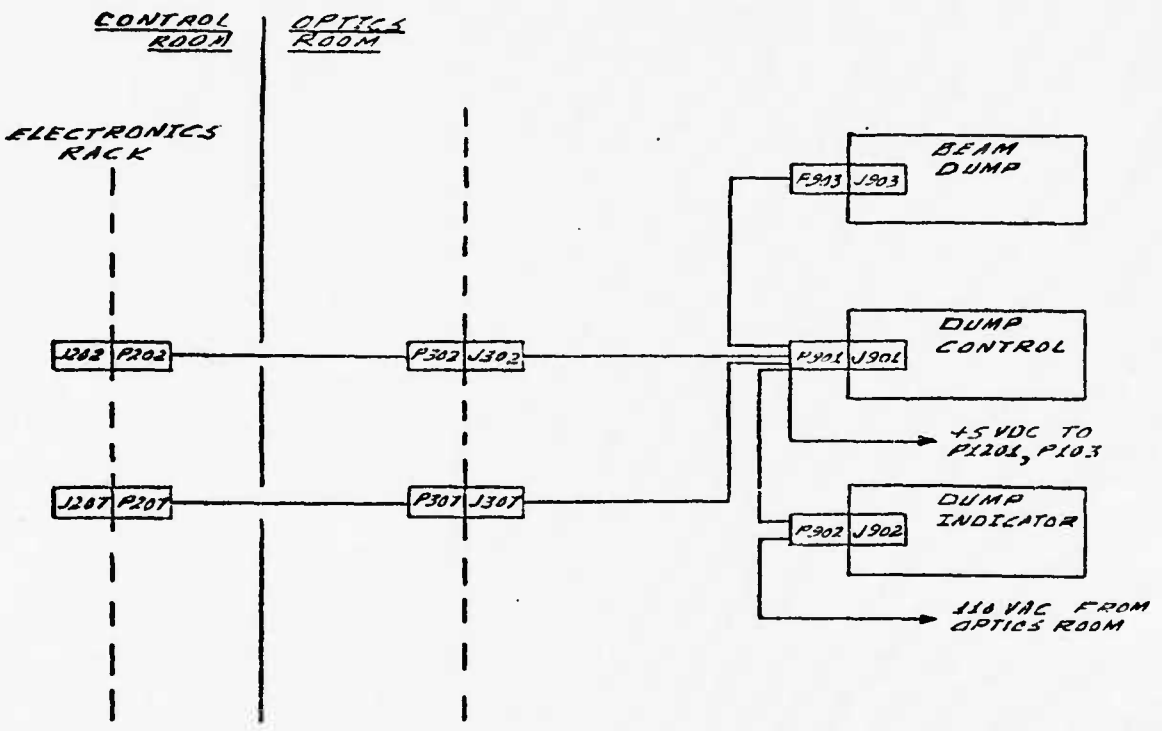


Interferometer X-Y Encoders

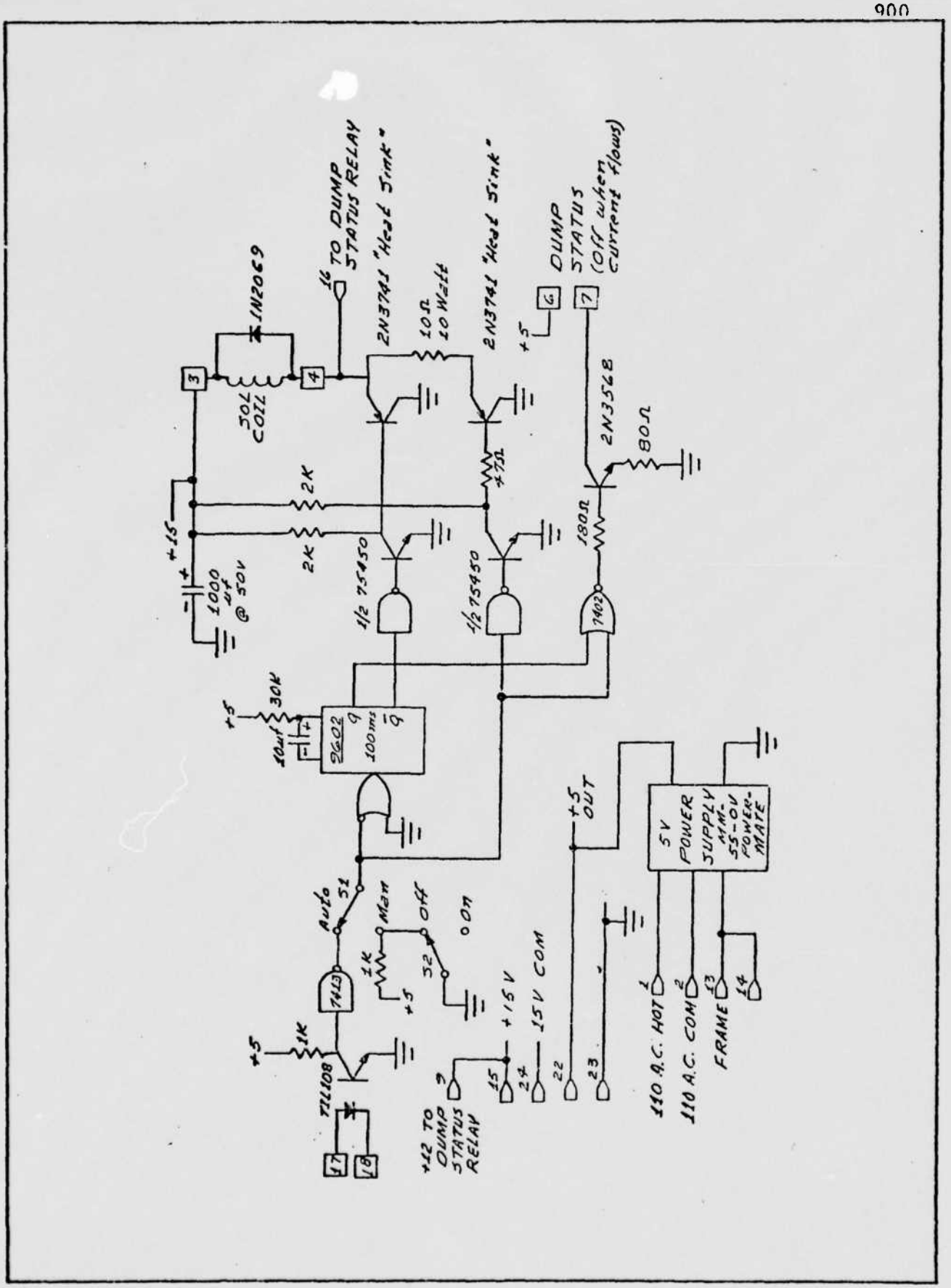


Connector at Interferometer X-Y Encoder Box

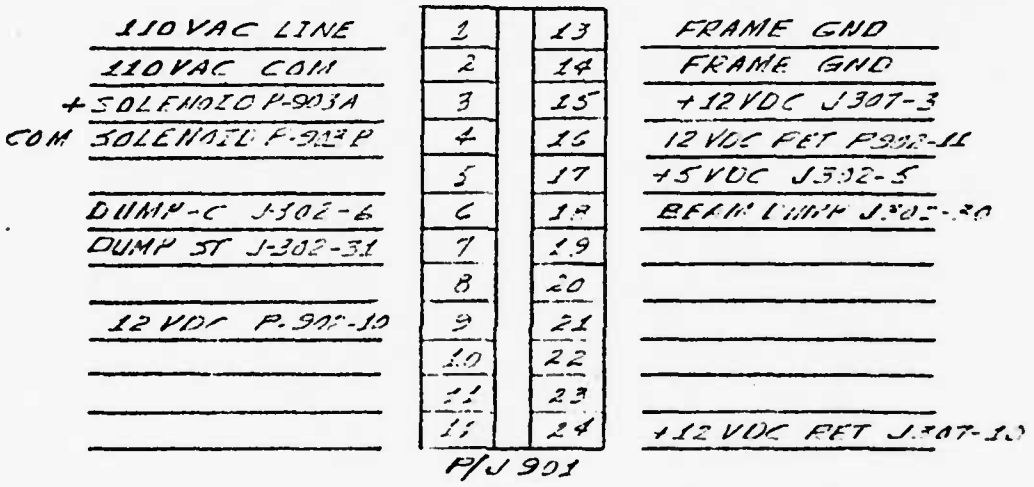
2.8 PHOTOMETER BEAM DUMP (900 SERIES)



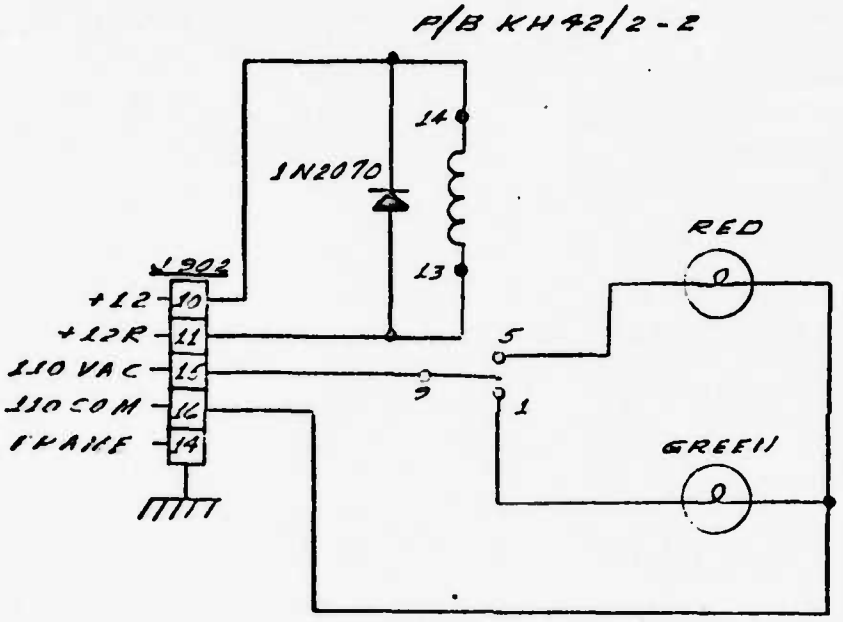
Beam Dump Harness Layout Block Diagram



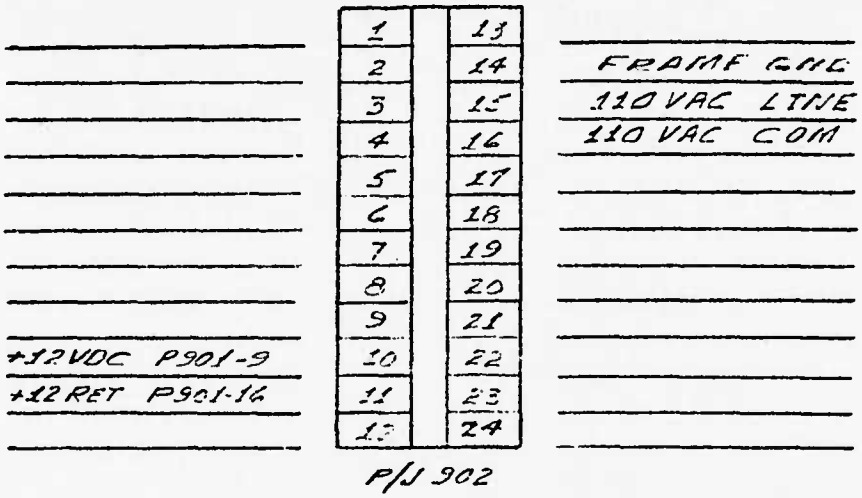
Photometer Beam Dump

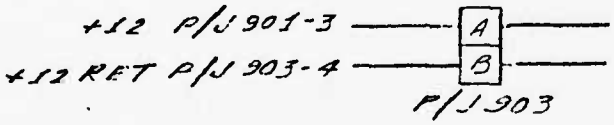


Connector at Photometer Beam Dump Control Unit



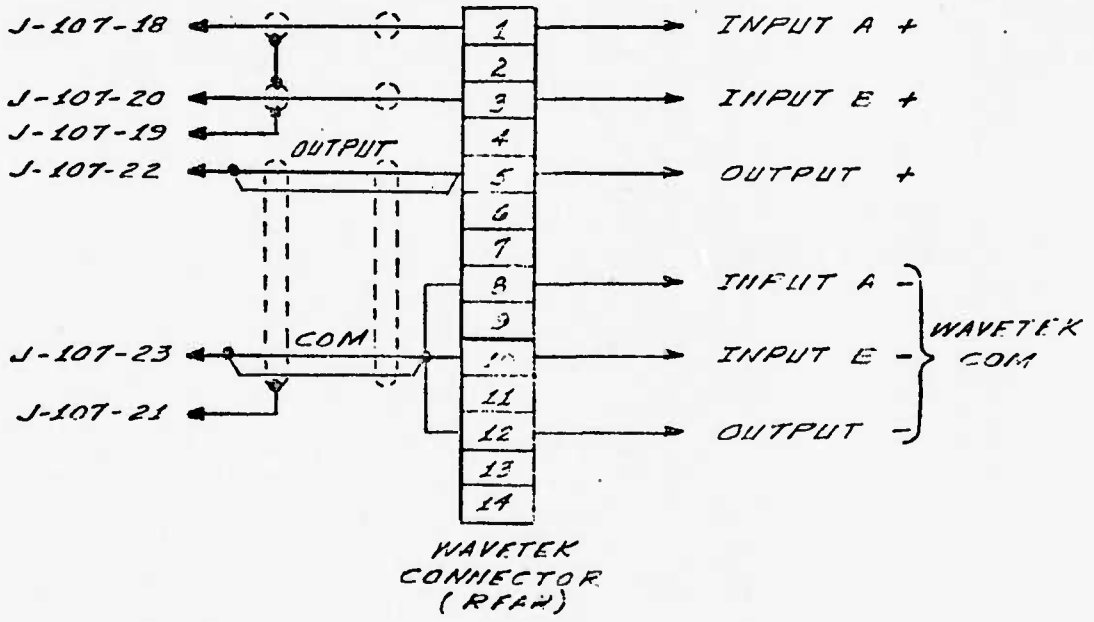
Beam Dump Indicator





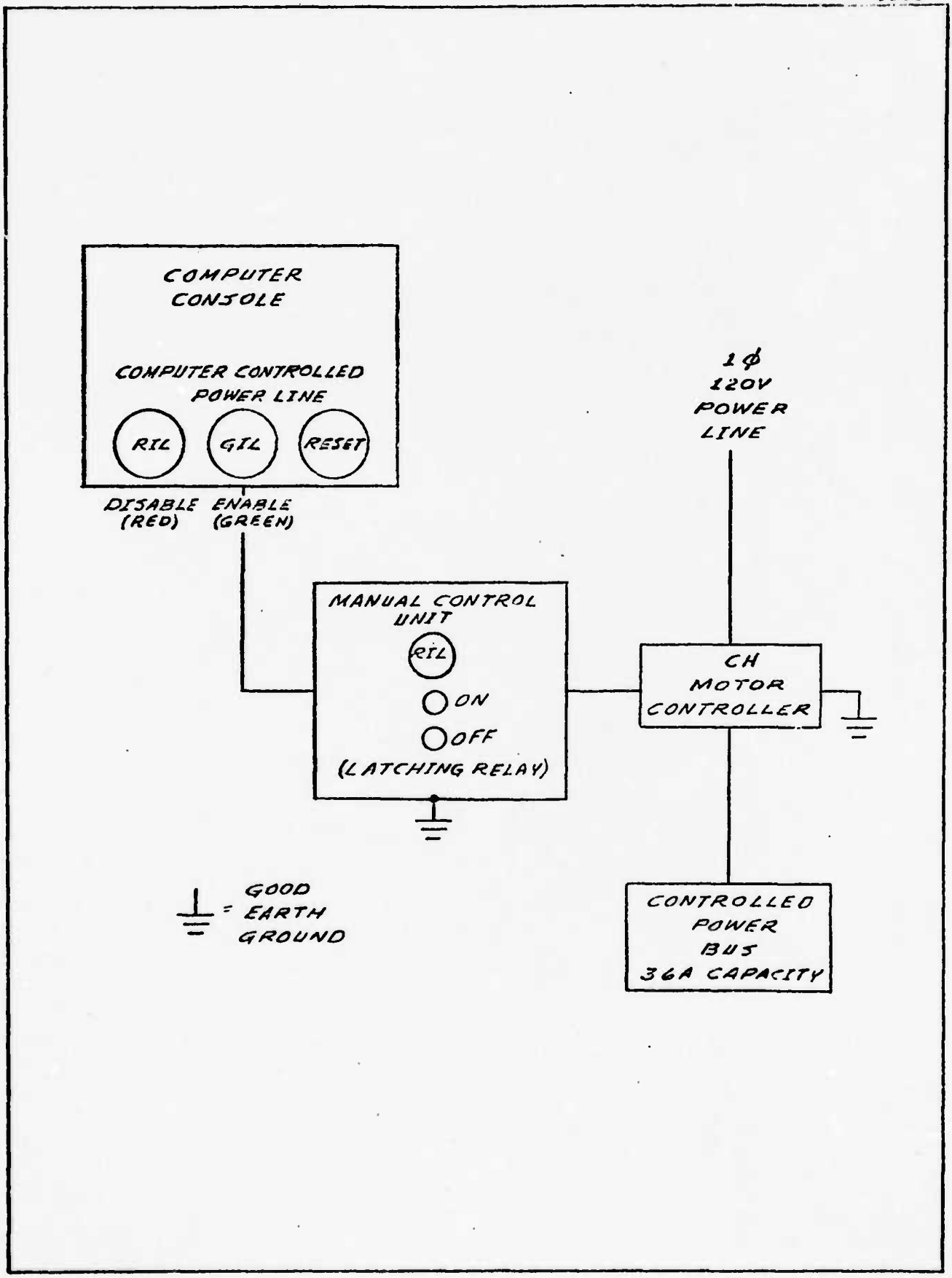
Connectors at Beam Dump Indicator and Beam Dump

2.9 WAVETEK INTERCONNECTING CABLE (1000 SERIES)

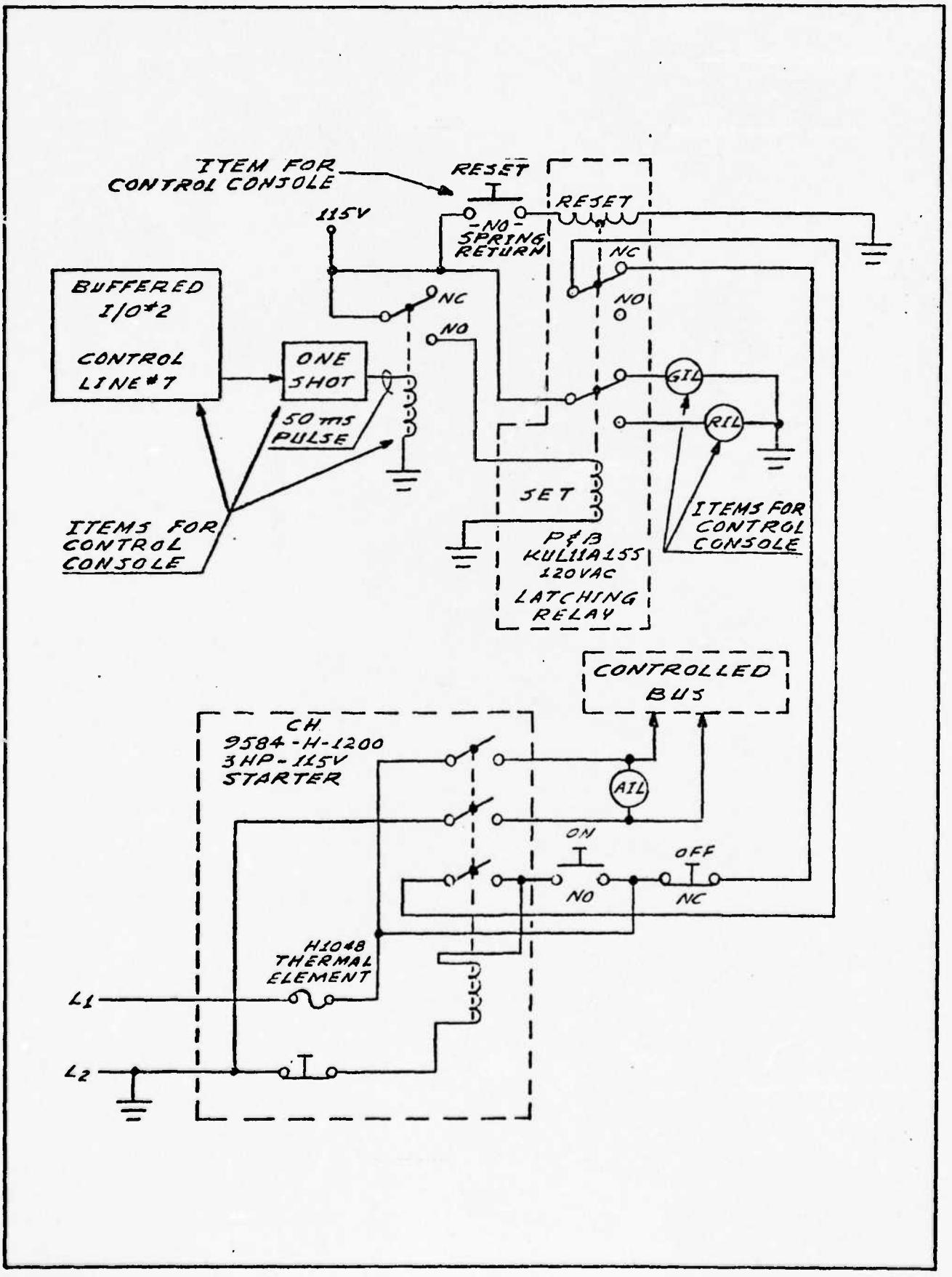


Wavetek Interconnecting Cable

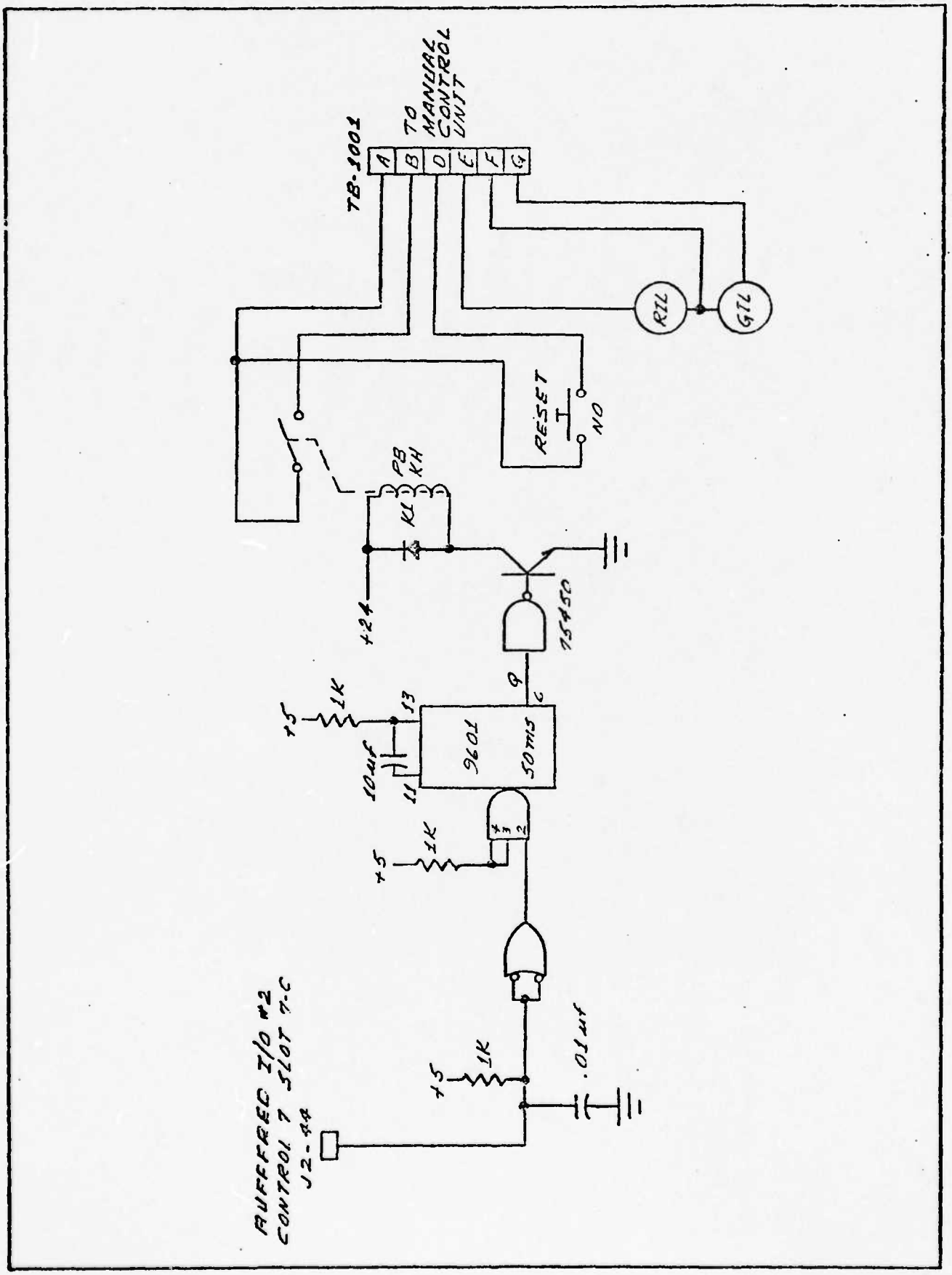
2.10 COMPUTER-CONTROLLED POWER BUS (1100 SERIES)



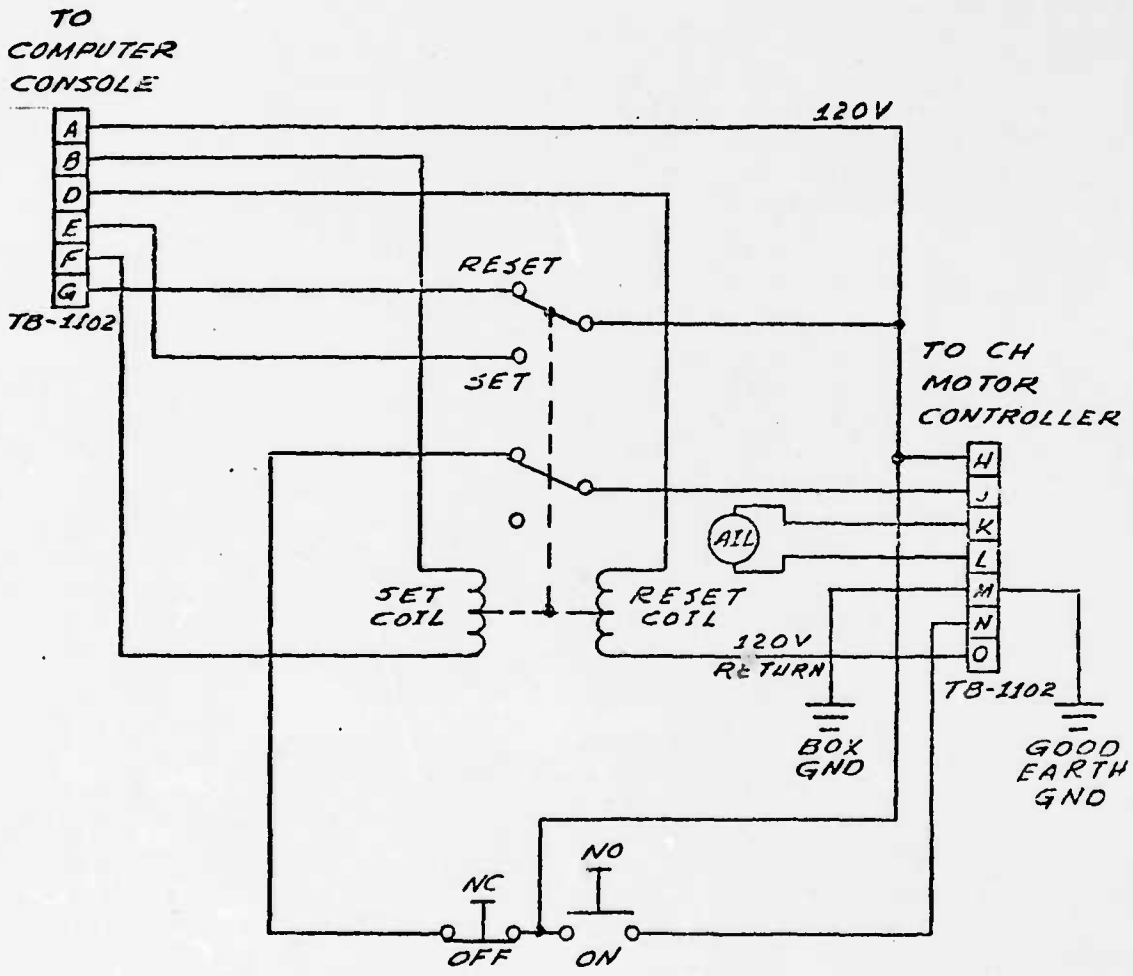
Computer-Controlled Power Bus (1 of 5, Block Diagram)



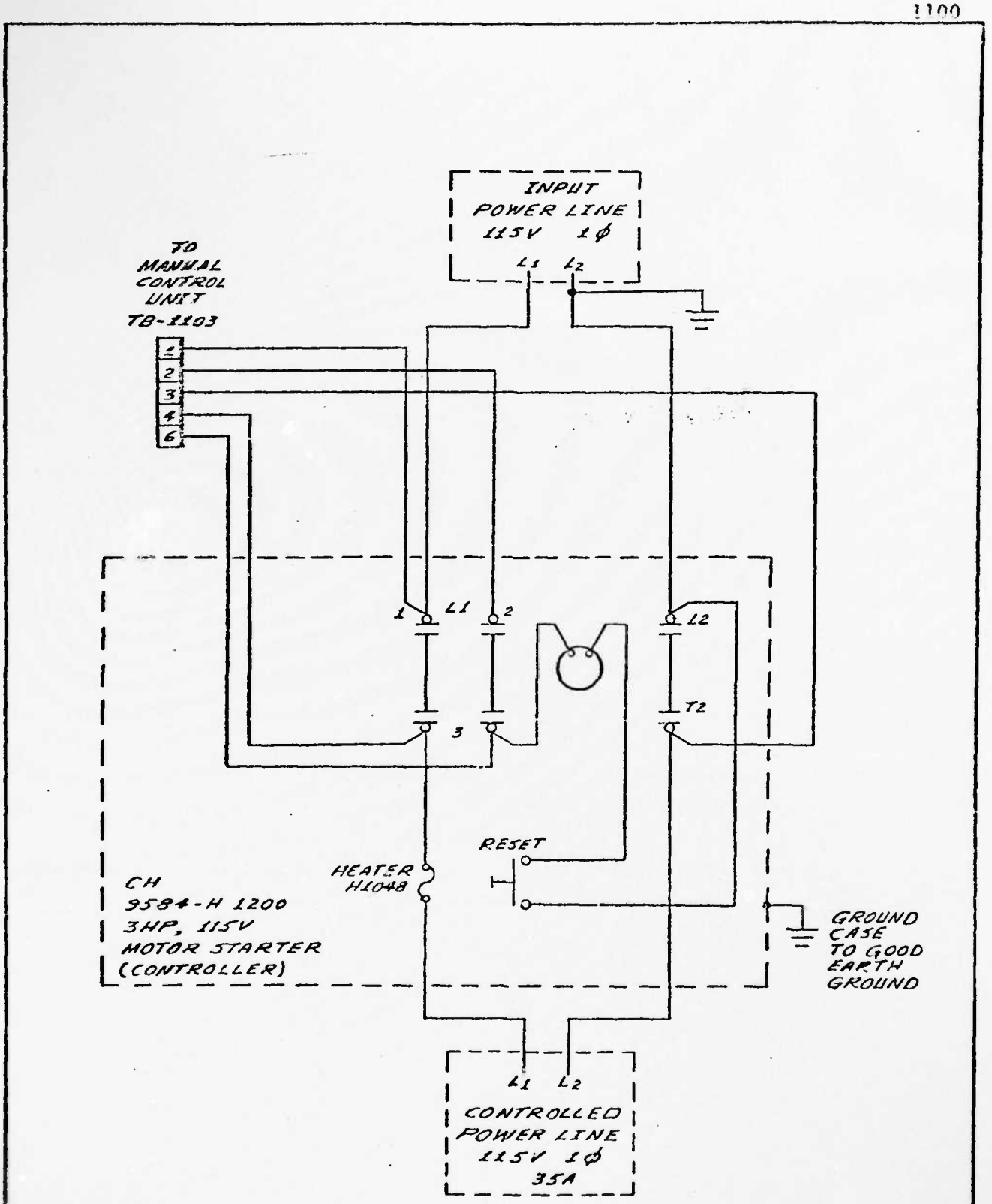
Computer-Controlled Power Bus (2 of 5, Wiring Schematic)



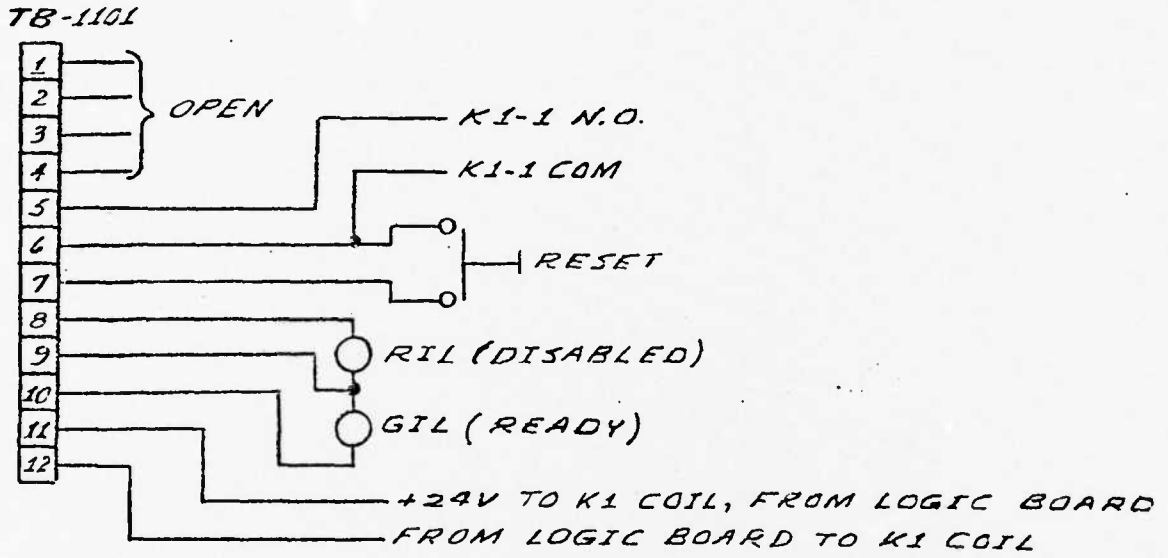
Computer-Controlled Power Bus (3 of 5, Computer Console Components)



Computer-Controlled Power Bus (4 of 5, Manual Control Unit)

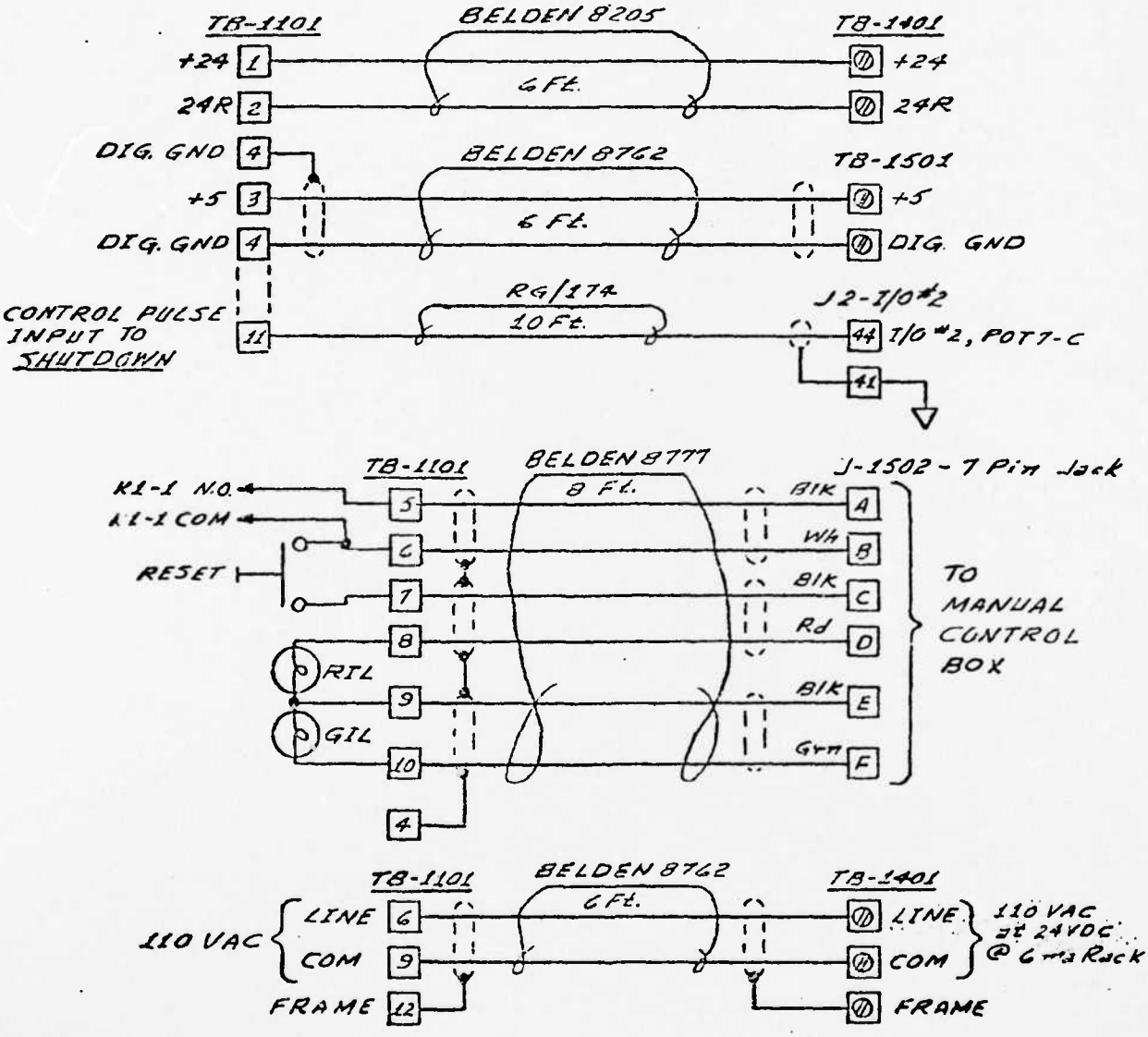


Computer-Controlled Power Bus (5 of 5, Reset Control Wiring)

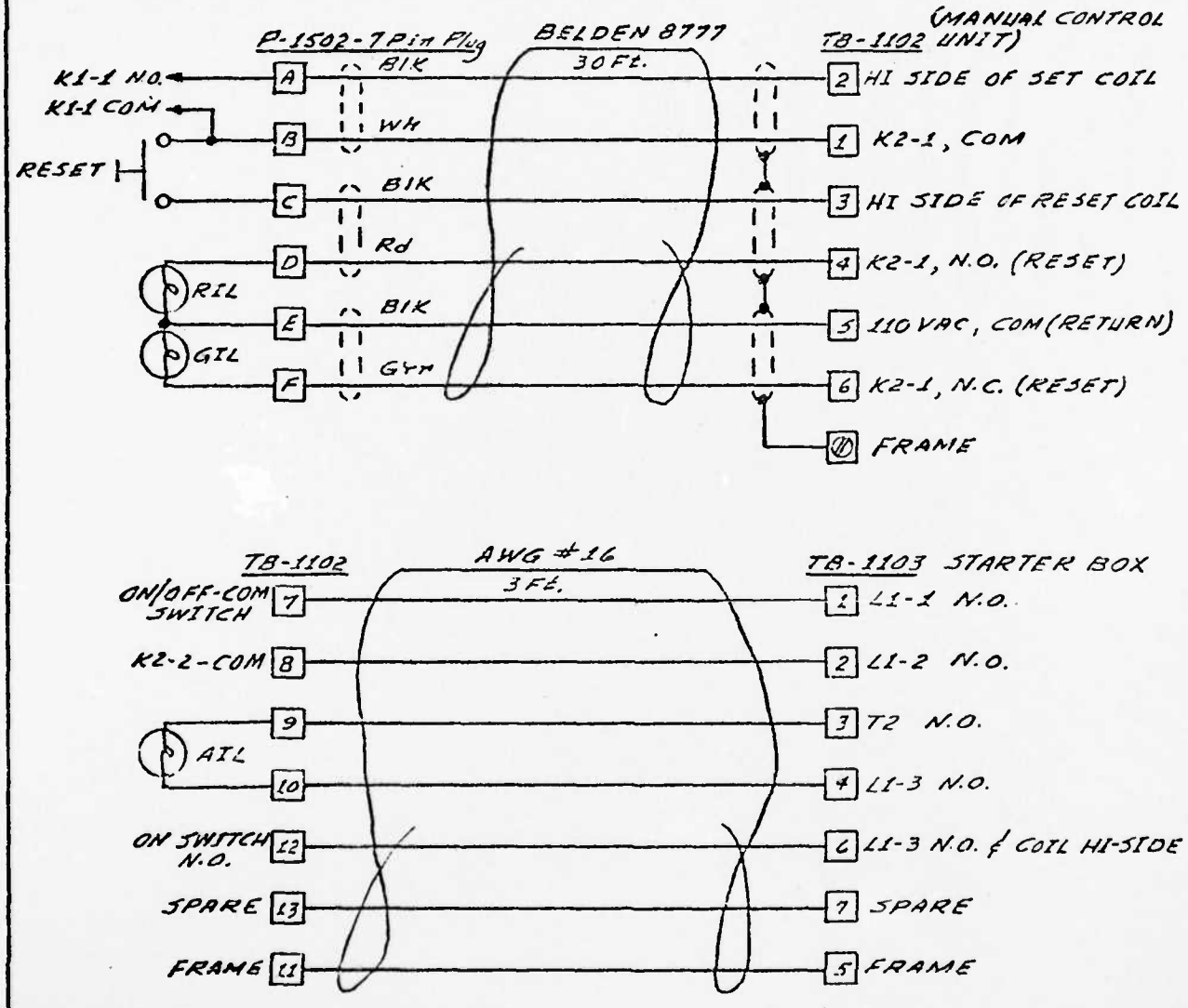


110 VAC : HI ON -6
: COM ON -9
PANEL GROUNDED
THRU SHIELD ON 110V
CABLE TO 24 VDC PANEL

Computer Controlled Power Panel Terminal Connections

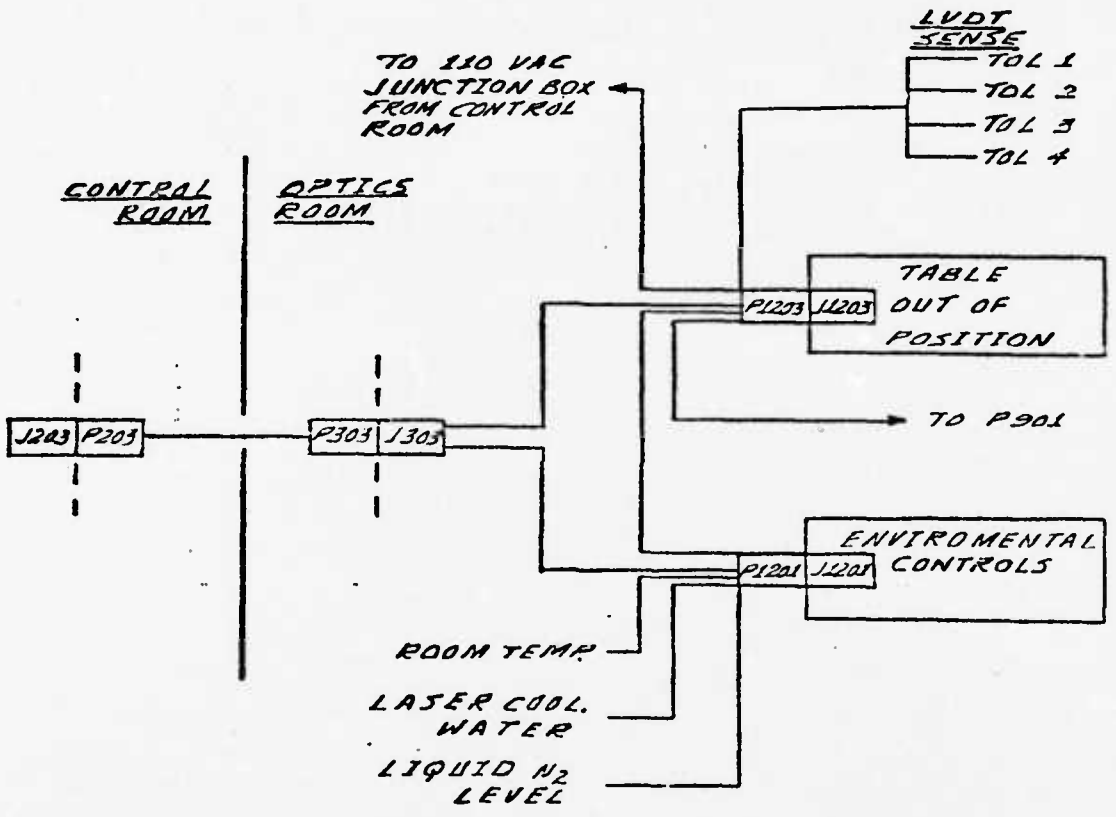


Terminal Boards and Cabling for Computer-Controlled Power Bus
(Sheet 1 of 2)

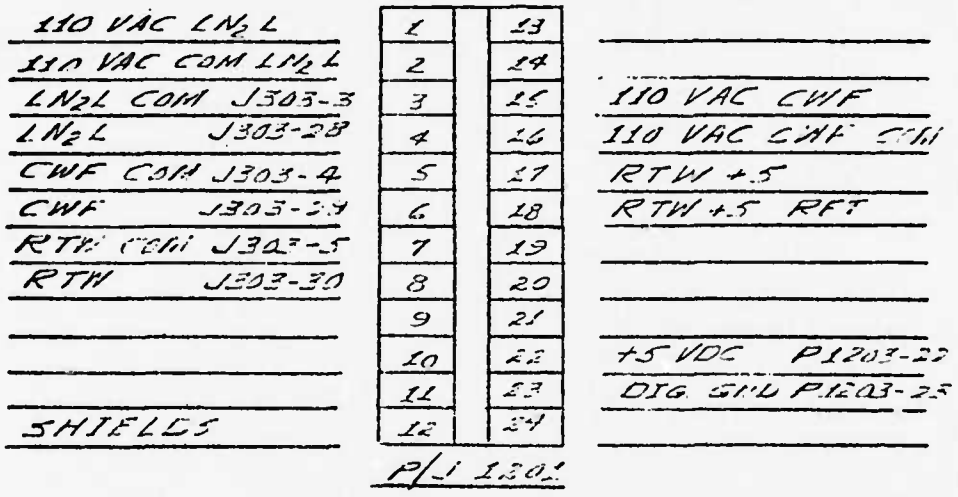


Terminal Boards and Cabling for Computer-Controlled Power Bus
(Sheet 2 of 2)

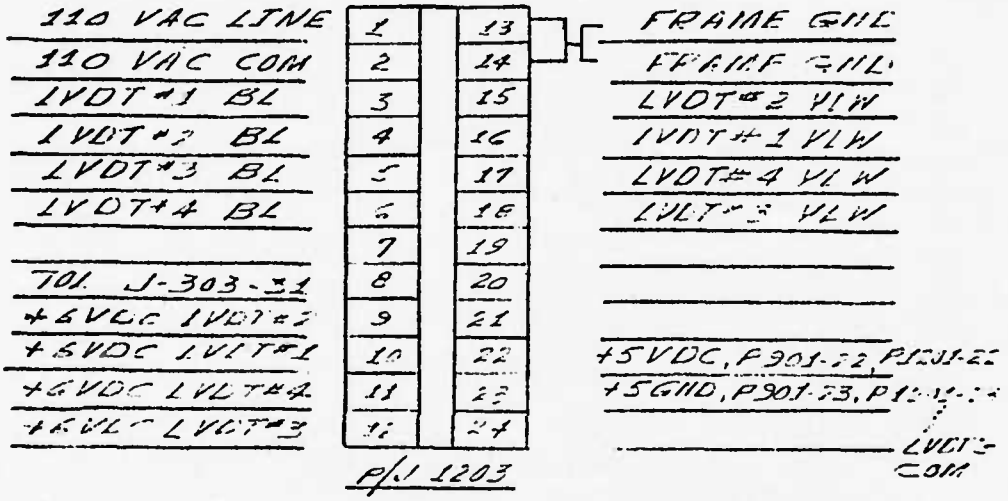
2.11 ENVIRONMENTAL ALARM SYSTEM (1200 SERIES)



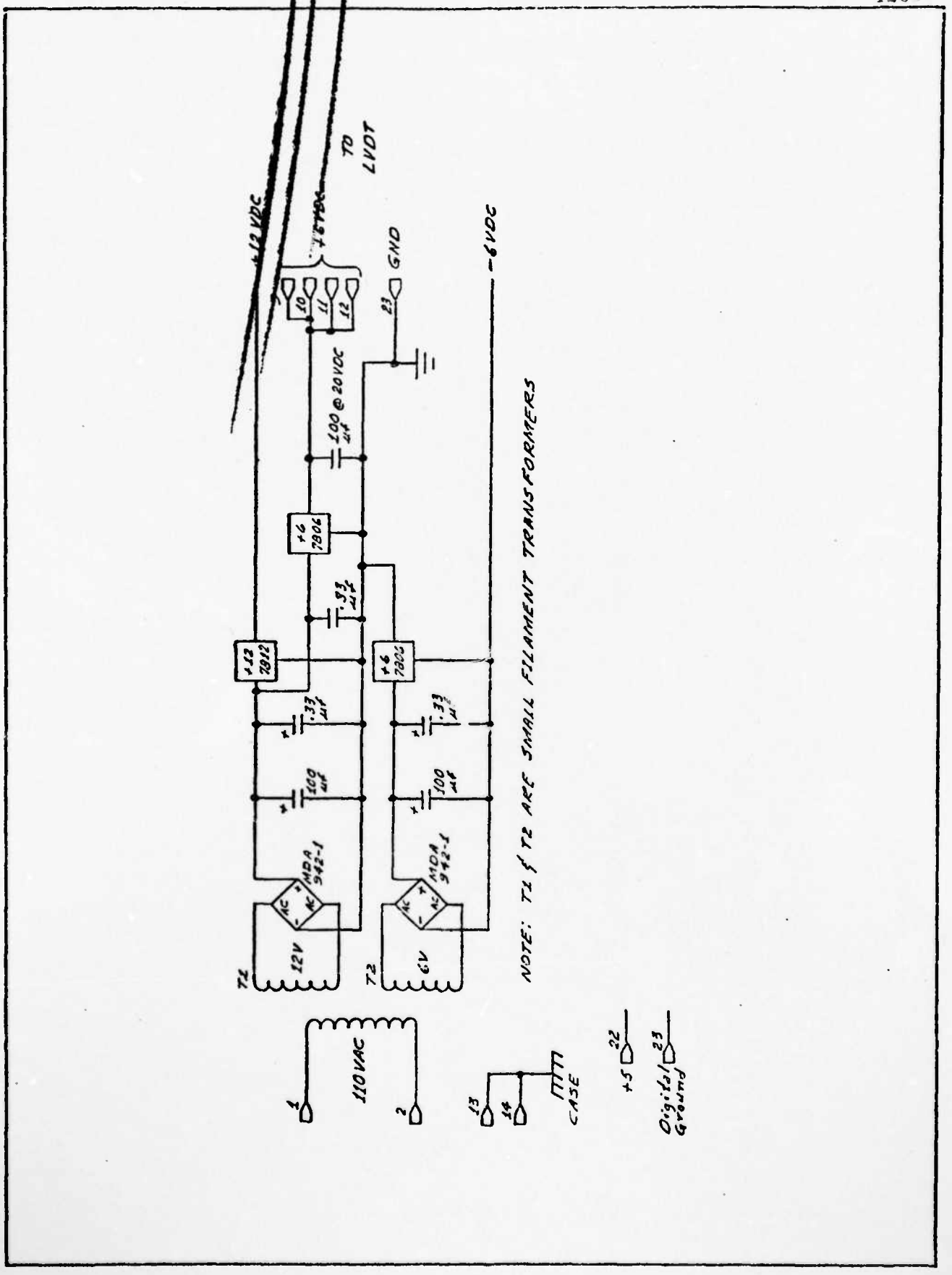
Environmental Controls Wiring Block Diagram



Connector at Environmental Alarm Control Box



Connector at Table-Out-of-Position Control Box



Power Supply for Table-Out-of-Position Transducers

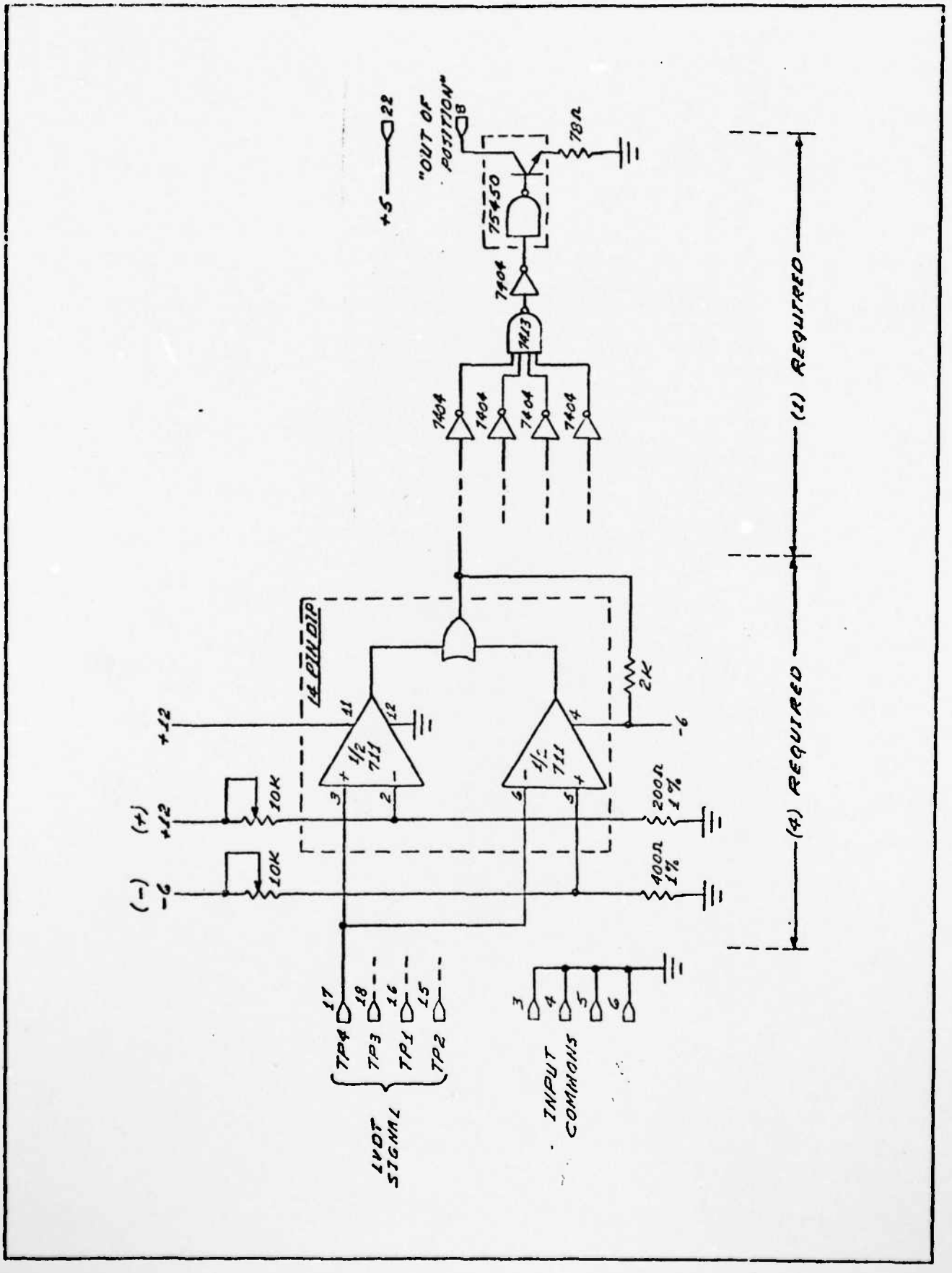
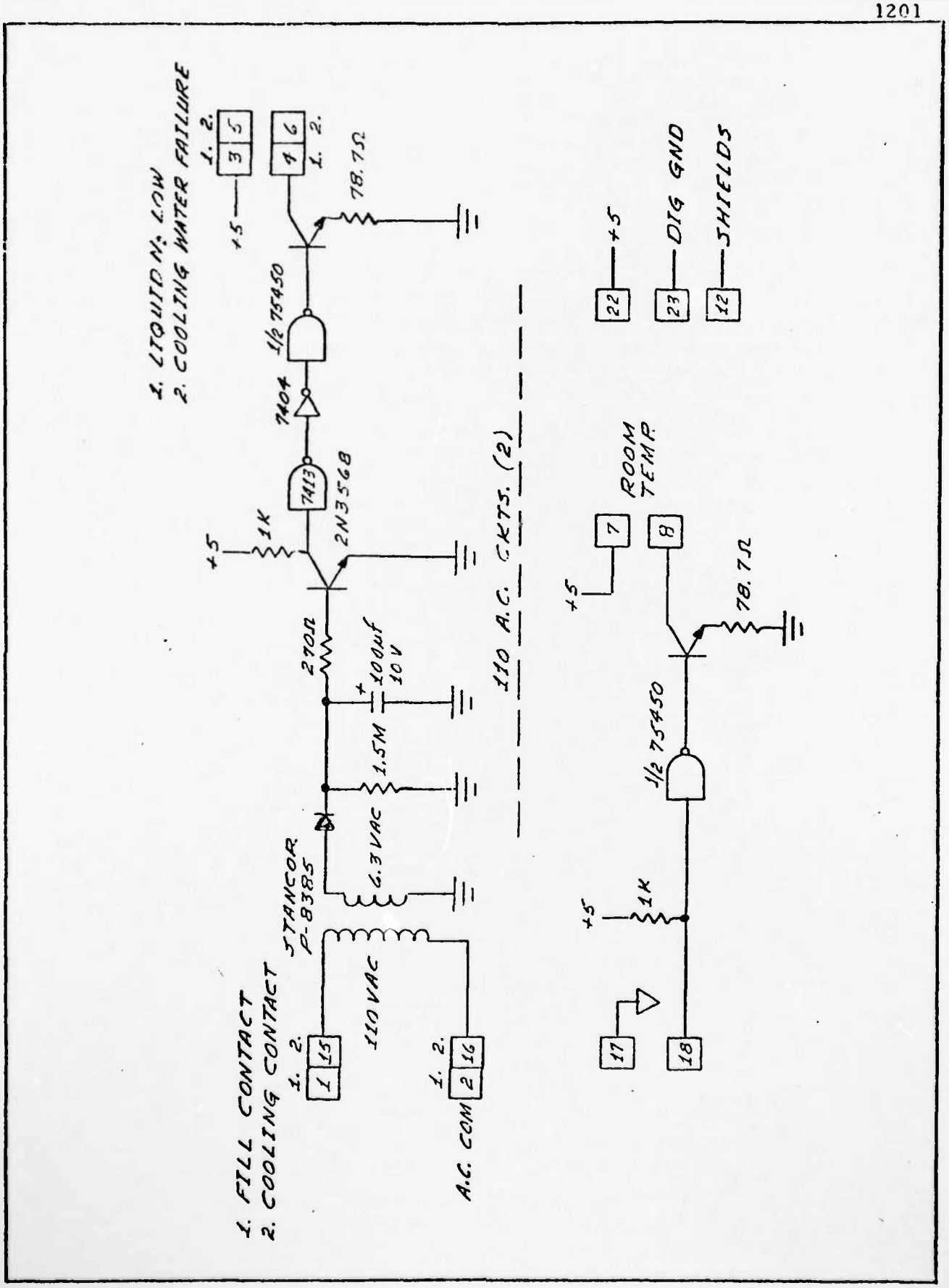
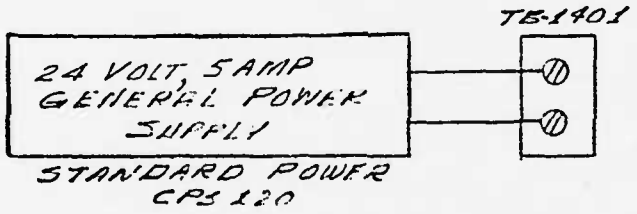


Table-Out-of-Position Sensor

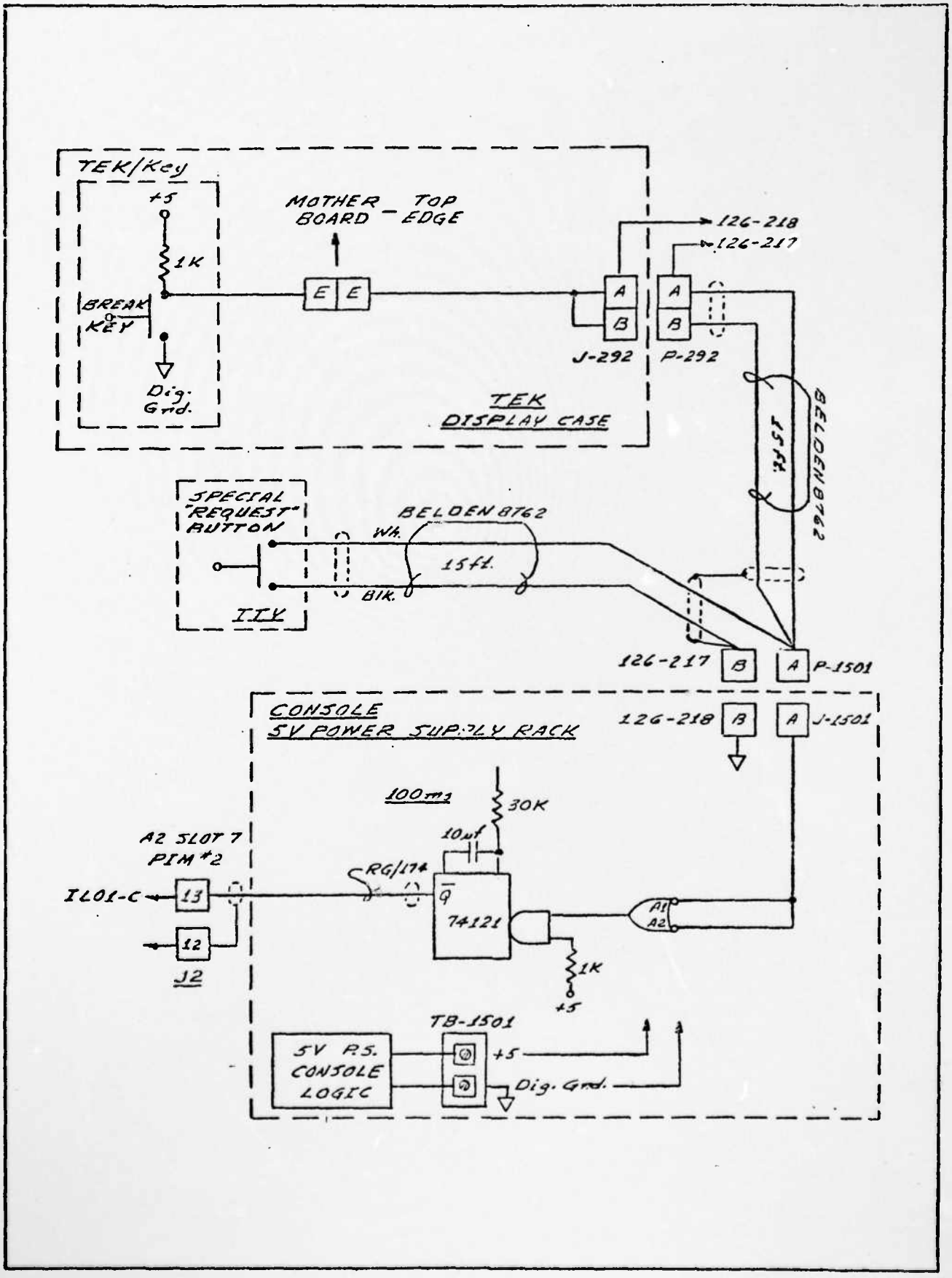


Optics Room Warning Circuits

2.12 OPERATOR MANUAL INTERVENTION CURCUITS AND 5 24-VOLT POWER SUPPLIES (1400, 1500 SERIES)



Power Supply Connections



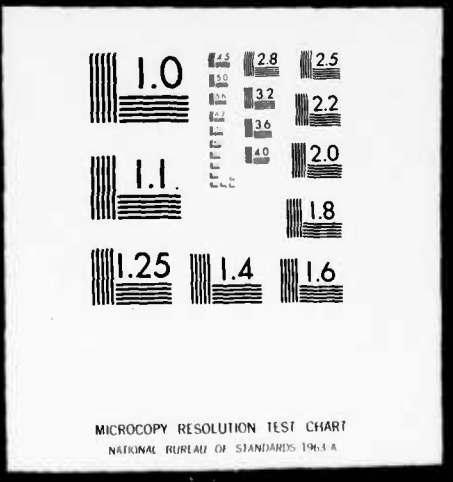
Operator Manual Intervention Circuit

AD-A039 811 DAYTON UNIV OHIO RESEARCH INST F/G 20/5
LASER WINDOW TEST APPARATUS OPERATION AND MAINTENANCE MANUAL (F--ETC(U)
MAY 75 F29601-73-C-0124
UNCLASSIFIED AFWL-TR-75-150-VOL-3 NL

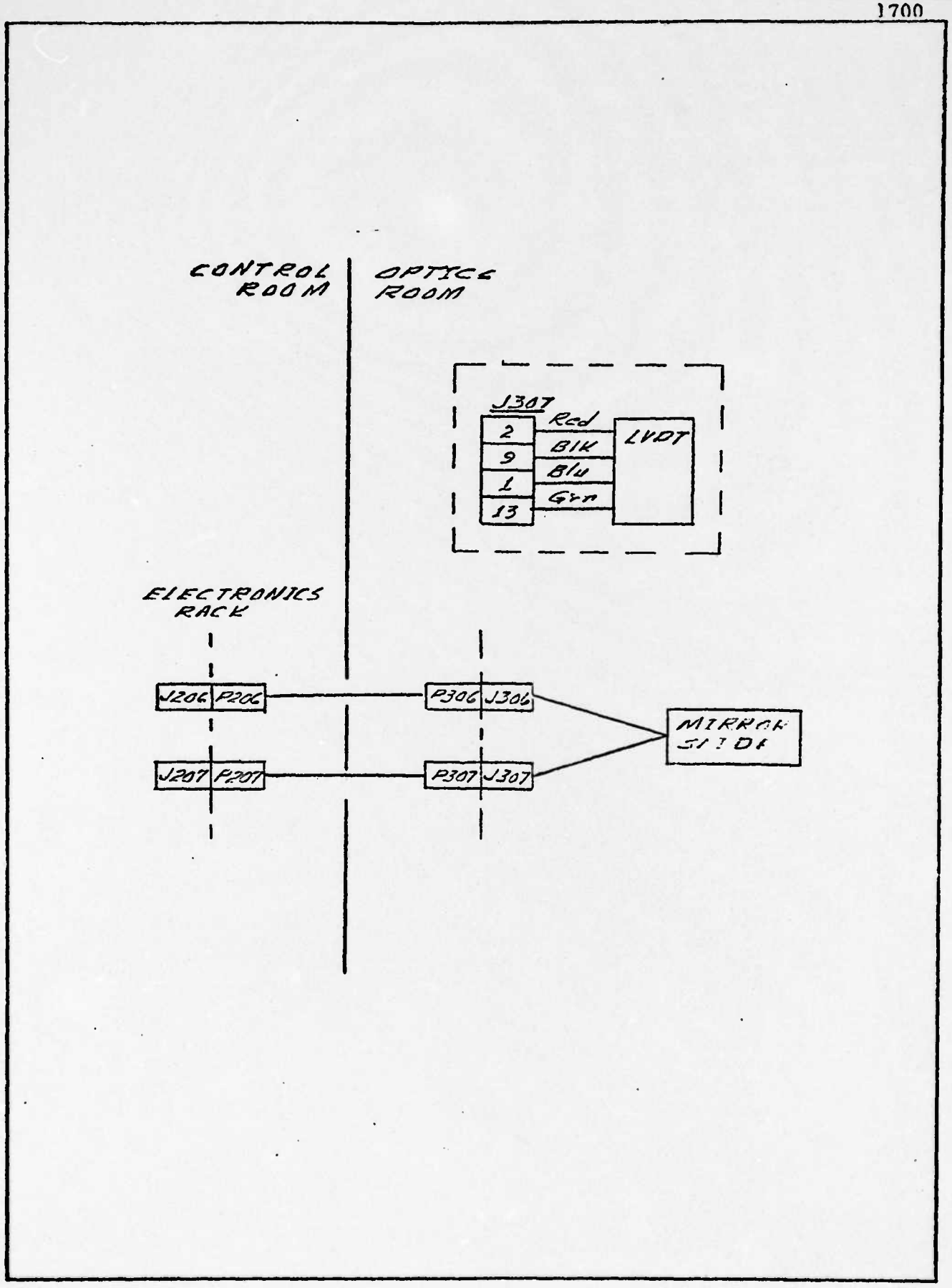
2 OF 2
AD A039 811

END

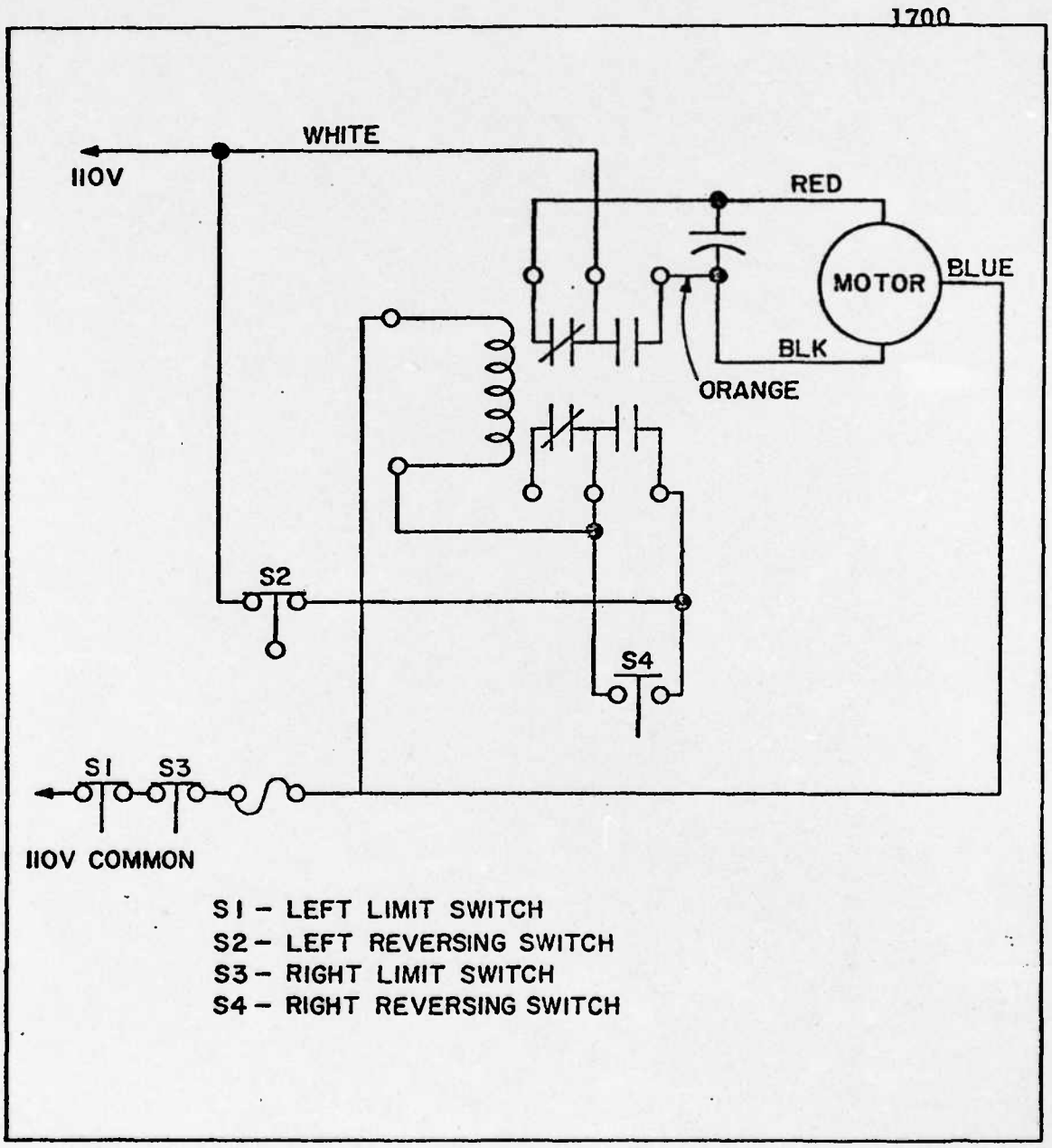
DATE
FILMED
6-77



2.13 DOPPLER MIRROR (1700 SERIES)



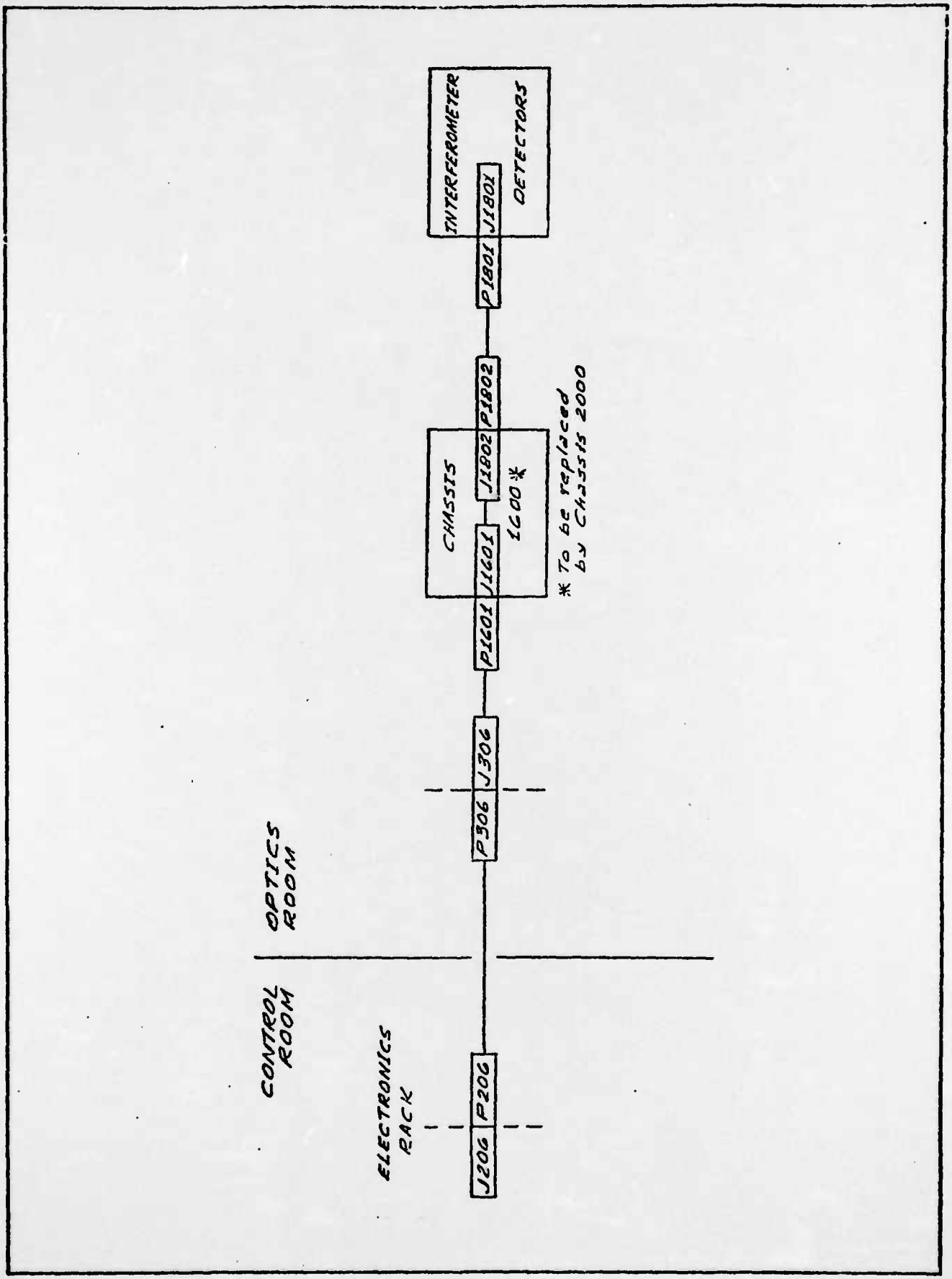
Doppler Mirror Wiring Block Diagram



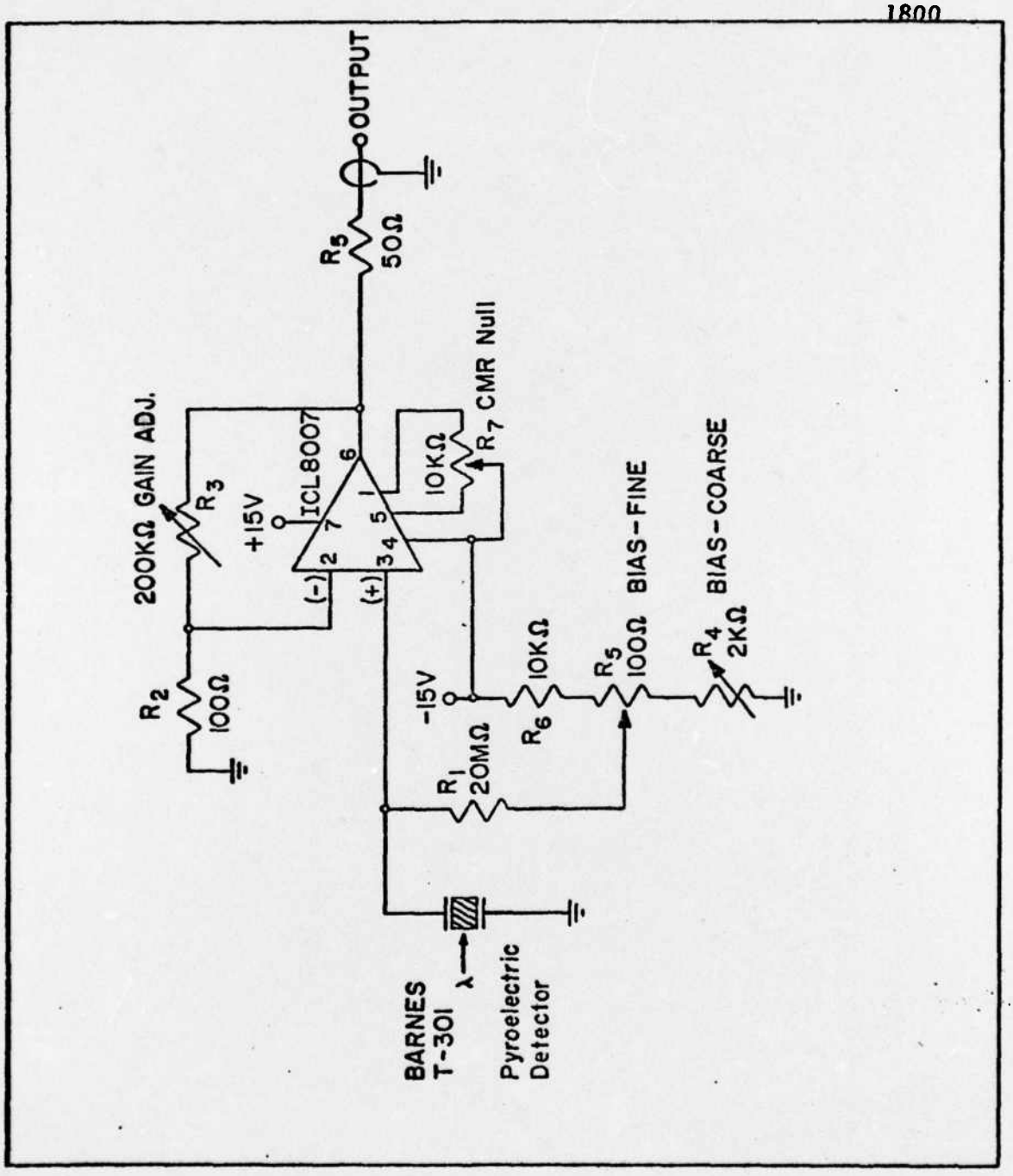
Doppler Mirror Motor Control

May 1975

2.14 INTERFEROMETER DETECTOR CIRCUITS (1800 SERIES)

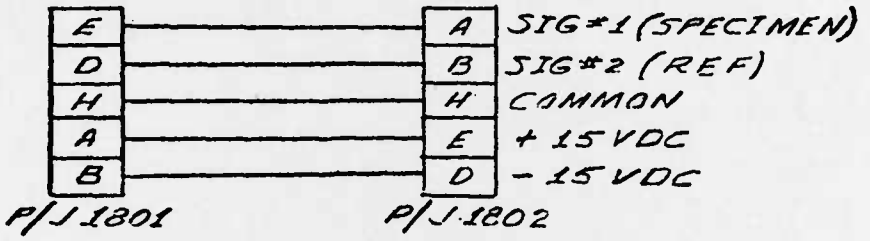


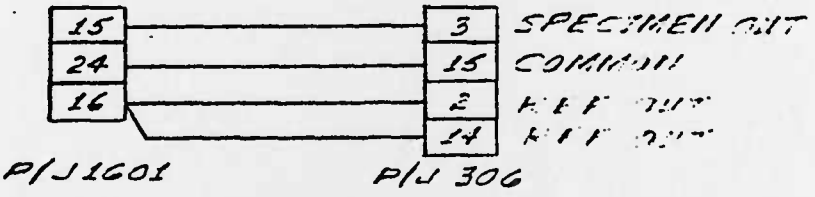
Interferometer Wiring Block Diagram



Interferometer Detector Circuits

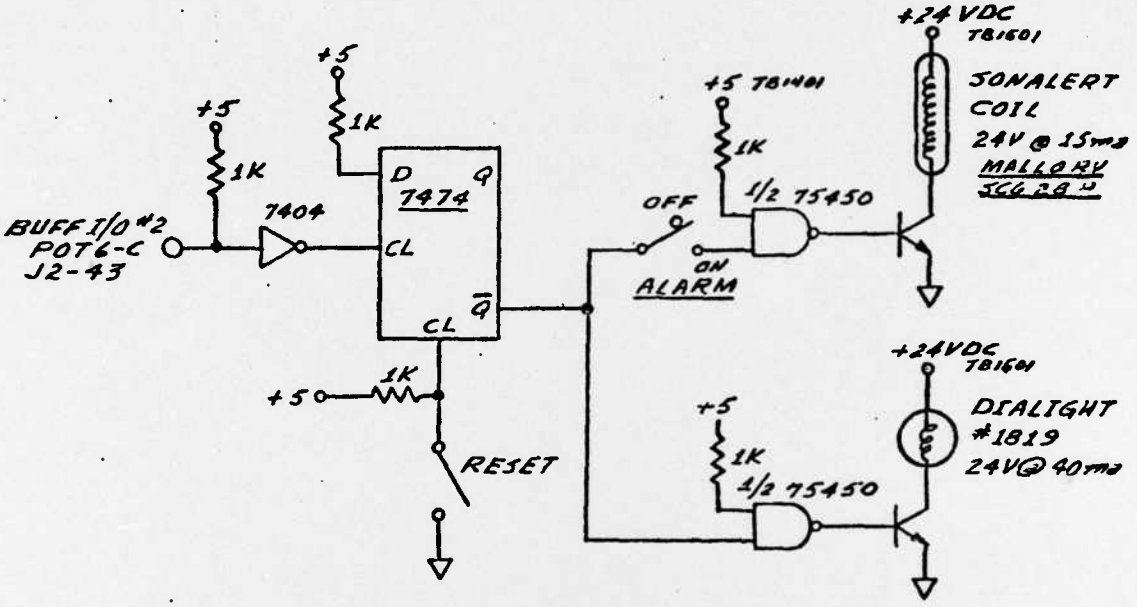
May 1975

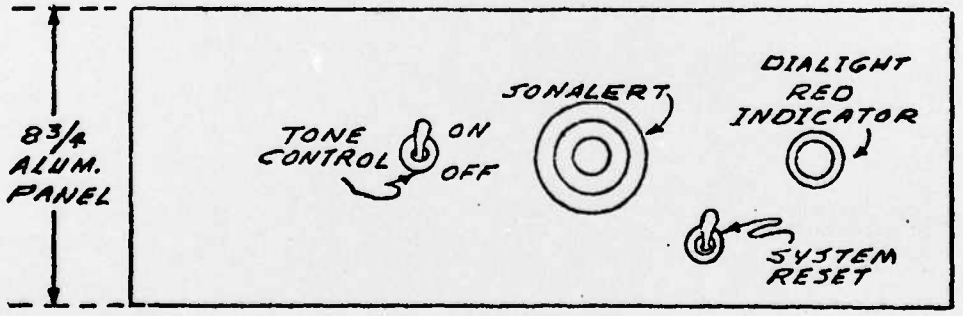




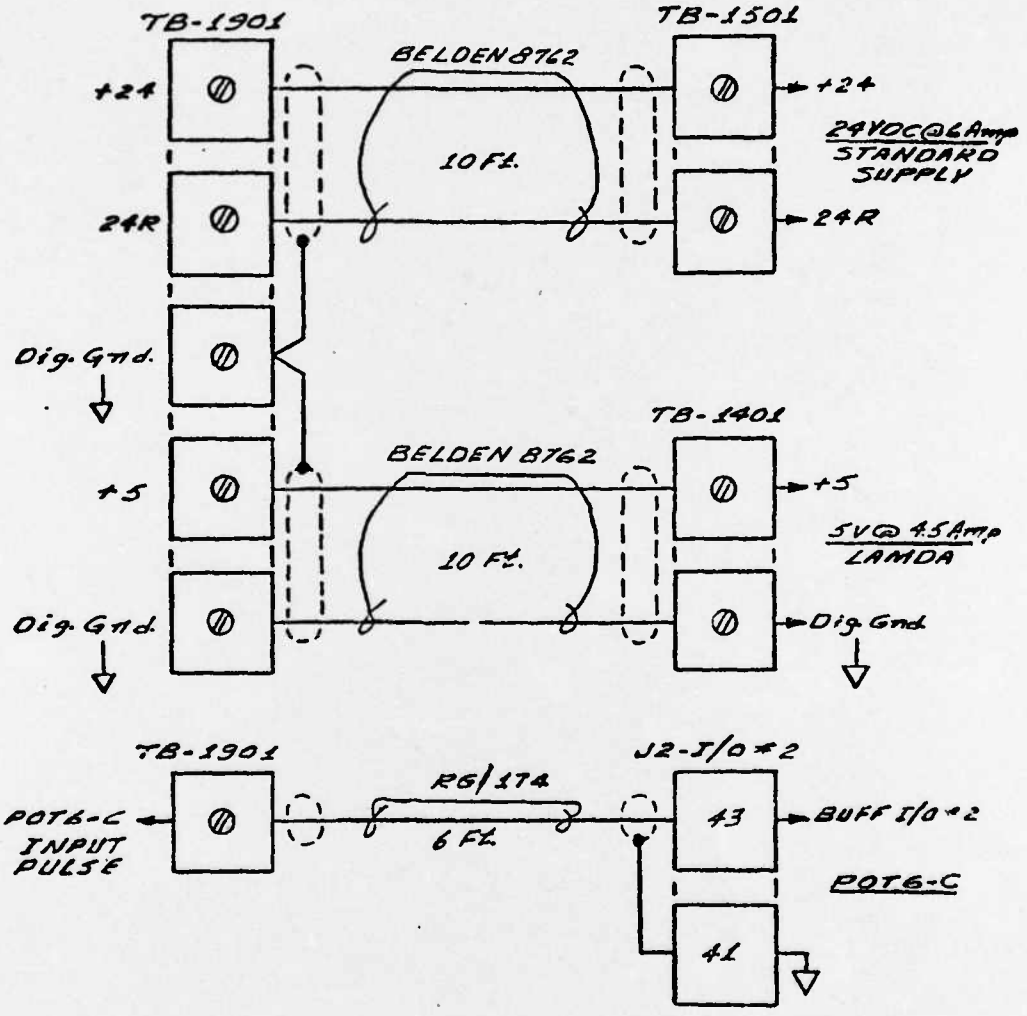
Connectors in Interferometer Detector Circuits

2.15 AUDIBLE/VISUAL ALARM (1900 SERIES)



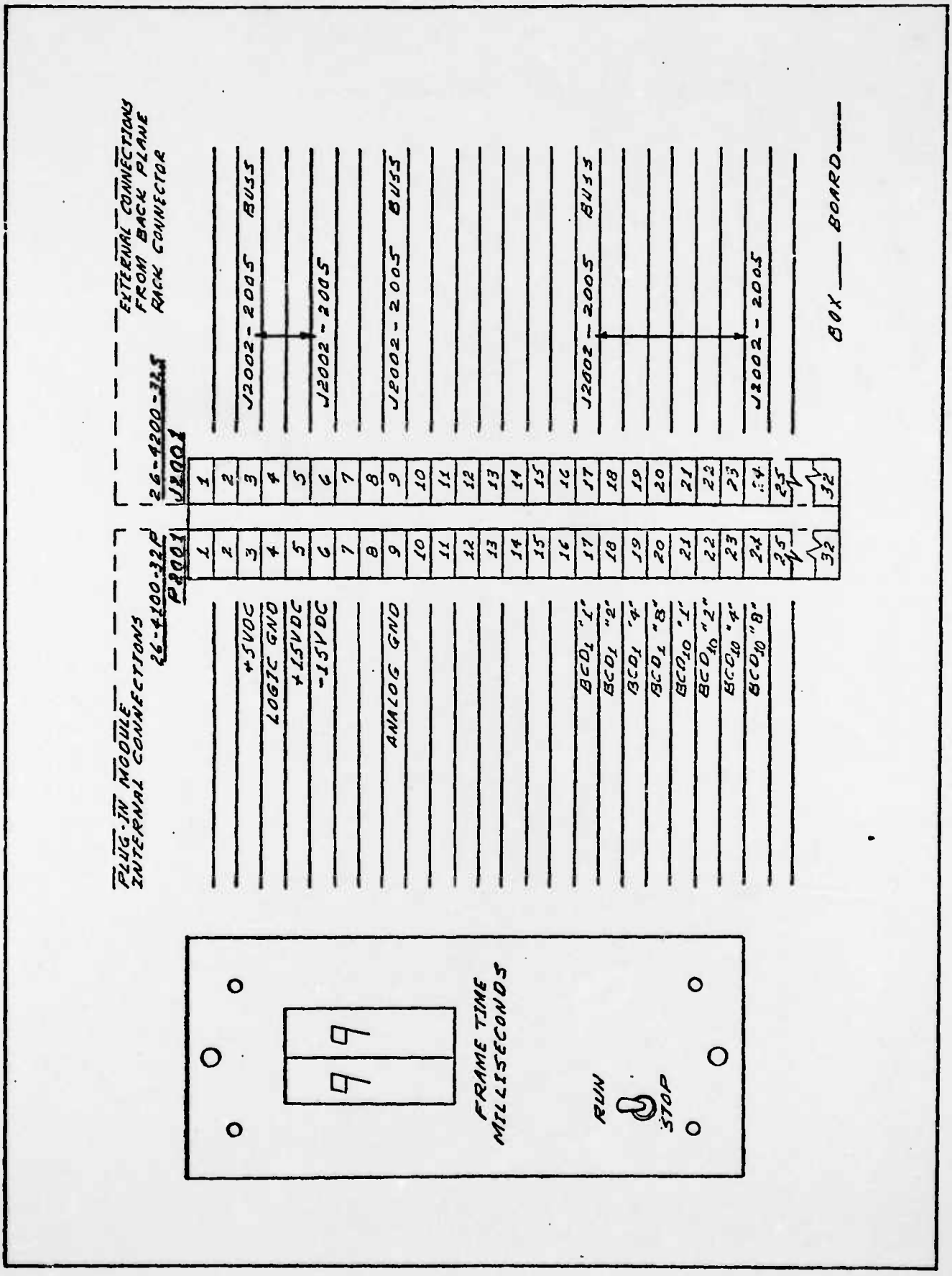


Audible/Visual Alarm Circuit

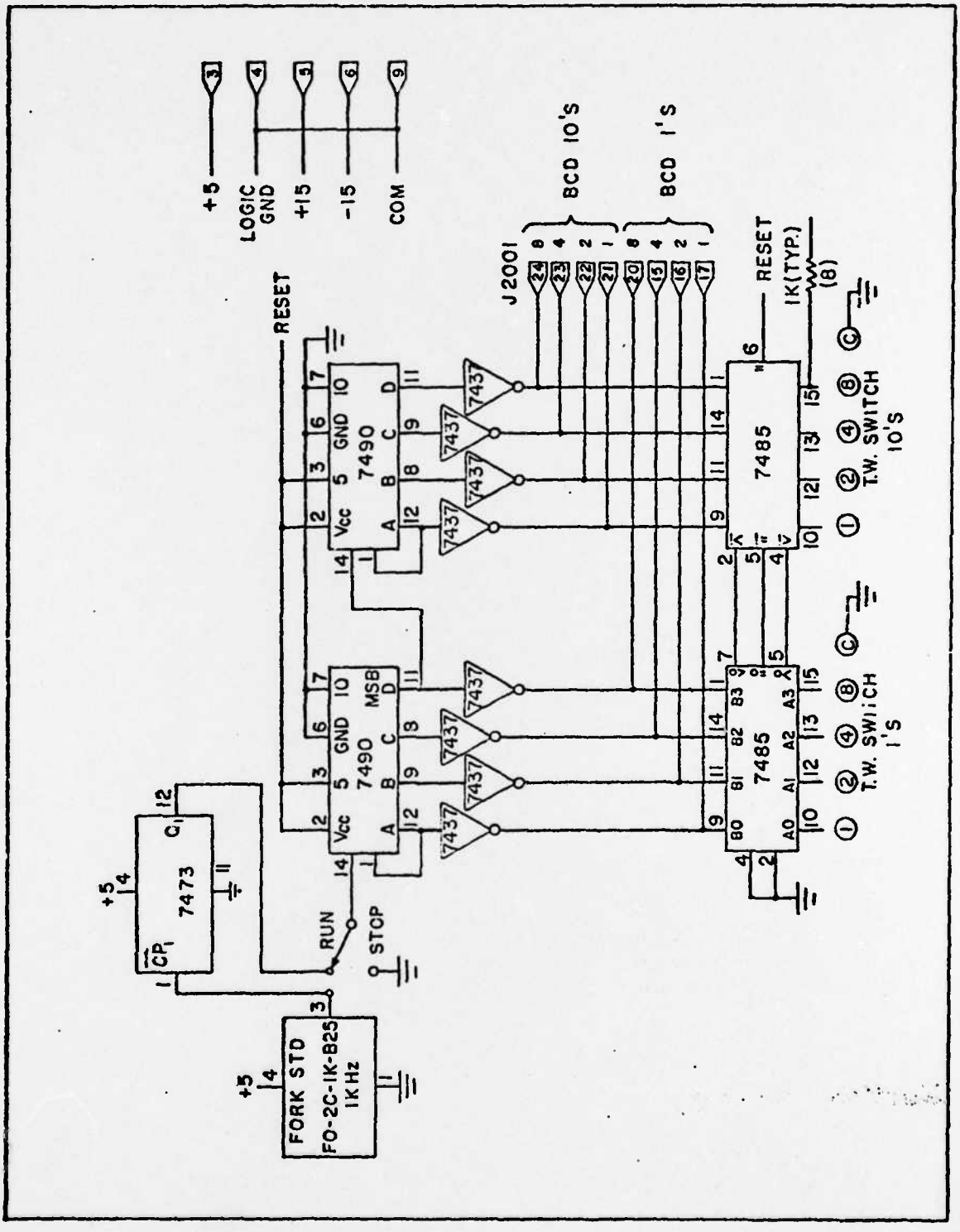


Audible/Visual Alarm Harness

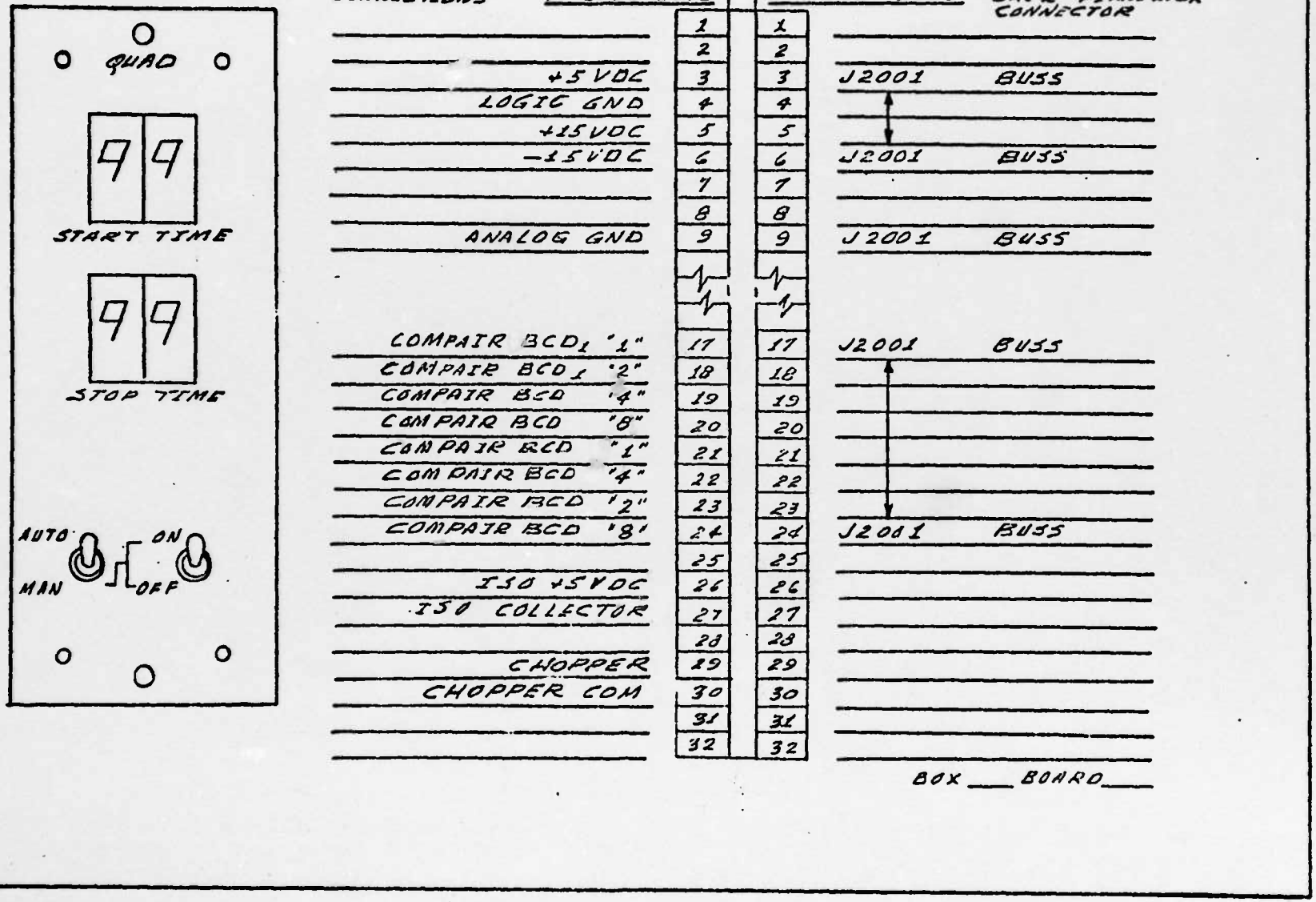
2.16 REVISED FRAME AND QUAD SYNC PULSE GENERATOR CHASSIS (2000 SERIES)

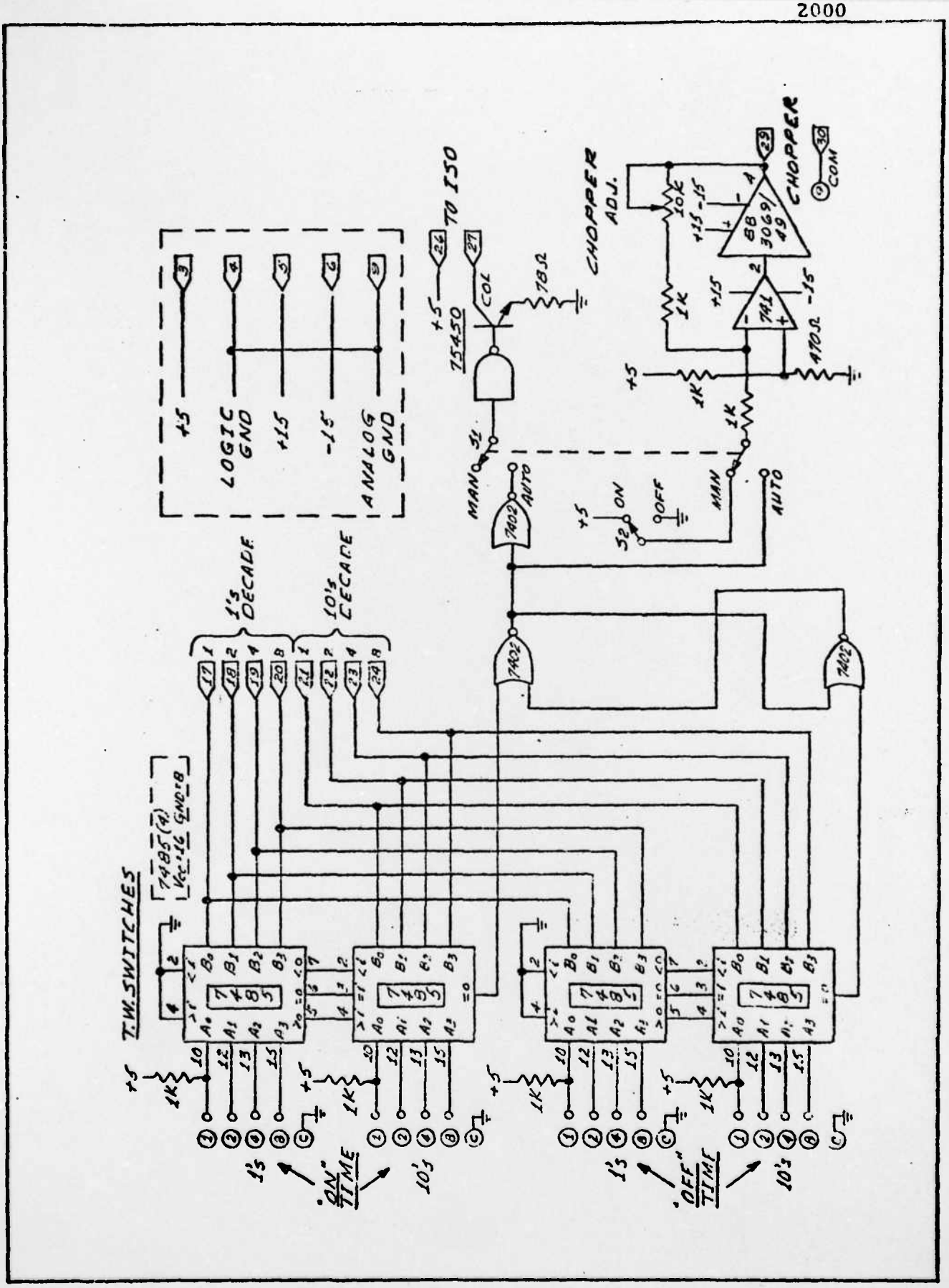


Frame and Quad Sync Clock Generator Connections

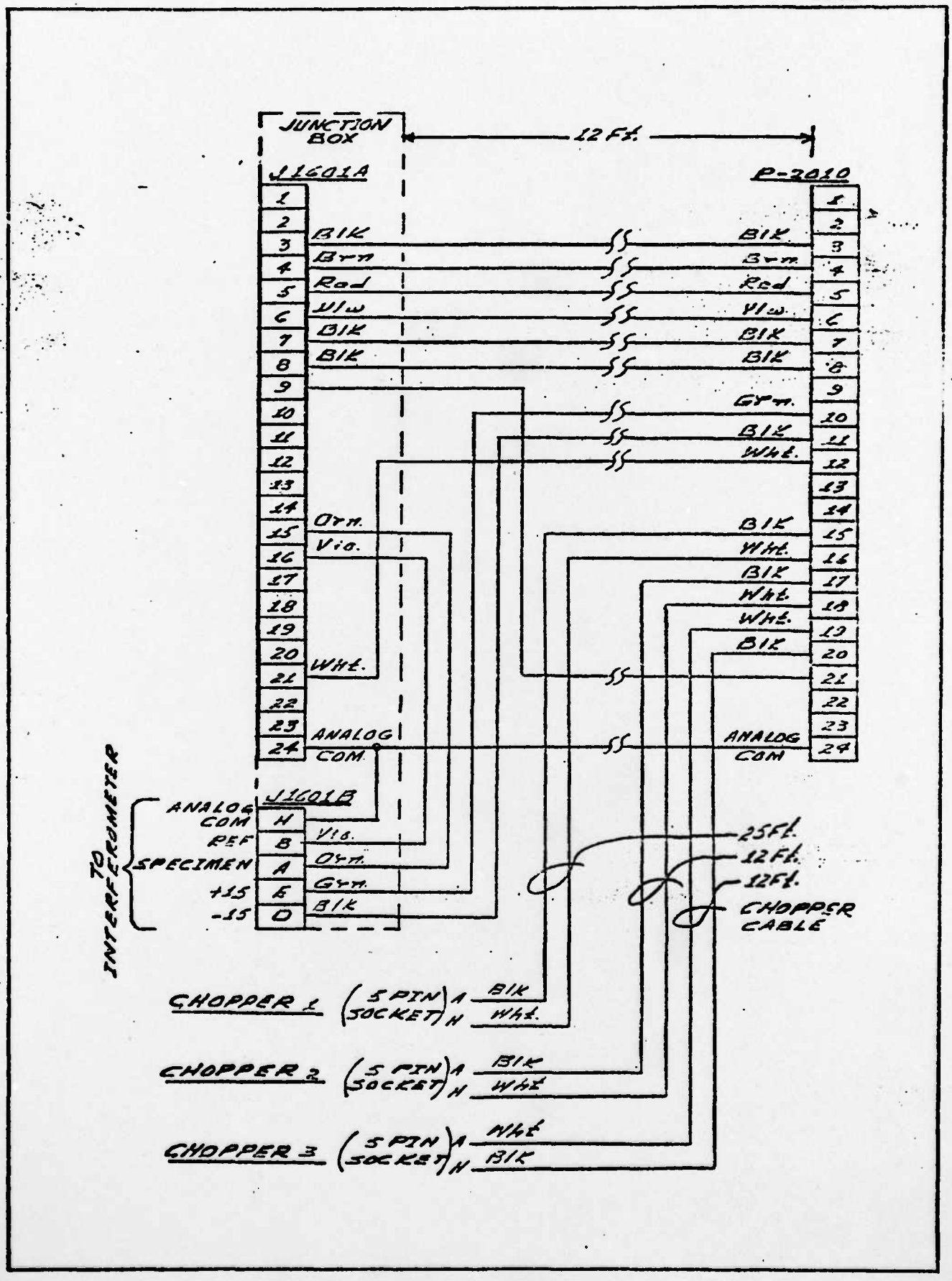


Frame and Quad Sync Clock Generator Diagram

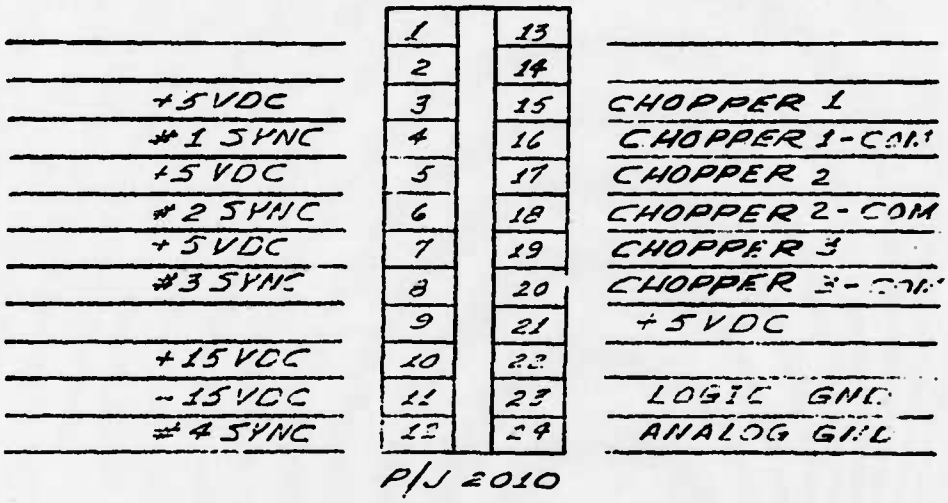

PLUG-IN MODULE INTERNAL CONNECTIONS
21-9100-32P
P-2002-2005
26-9200-325
J-2002-2005
EXTERNAL CONNECTIONS FROM BACK PLANE BACK CONNECTOR
QUAD
START TIME
STOP TIME
AUTO
MAN
ON
OFF
+5 VDC
LOGIC GND
+15 VDC
-15 VDC
ANALOG GND
COMPAIR BCD 1 "1"
COMPAIR BCD 1 "2"
COMPAIR BCD "4"
COMPAIR BCD "8"
COMPAIR BCD "1"
COMPAIR BCD "4"
COMPAIR BCD "2"
COMPAIR BCD "8"
ISO +5 VDC
ISO COLLECTOR
CHOPPER
CHOPPER COM
J2001 BUSS
J2001 BUSS
J2001 BUSS
J2001 BUSS
J2001 BUSS
BOX ___ BOARD ___



Frame and Quad Sync Decoder



Frame and Quad Sync Cable



Frame and Quad Sync Connections


ATE
ME